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EDITED BY R. H. JACKSON.

Published Quarterly by the Institute.

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Colonel Sir G. S. Clarke, K. C. M. G., F. R. S.

LESSONS OF THE SPANISH-AMERICAN WAR,
Captain B. H. McCalla, U. S. Navy.

THE LANDING AT BAIQUIRI,
Jean Legrand in *Marine Francaise*. Translated by Lieut. F. A. Traut, U. S. Navy.

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Captain Casper F. Goodrich, U. S. Navy.

HIGH EXPLOSIVES IN NAVAL WARFARE,
Professor P. R. Alger, U. S. Navy.

The Board of Control, having decided that officers contributing valuable articles should receive appropriate compensation, announces that the annual report shows an tncrease in both the sales and subscriptions, and the greatest annual increase of membership within the last ten years.

All officers and members are invited to submit articles upon subjects of interest to the service.

NOTICE.

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It now enters upon its twenty-seventh year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

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Sec. 1. The Institute shall consist of regular, life, honorary and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fee to the Secretary and Treasurer, or to the Corresponding Secretary of a Branch. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

PRIZE ESSAY, JANUARY 1, 1900.

TORPEDO CRAFT: TYPES AND EMPLOYMENT.

Motto: Experientia Docet.

By LIEUTENANT R. H. JACKSON, U. S. Navy.

The navy list on July 3, 1899, showed that we had, completed, twenty torpedo craft, and building, thirty-three more; in all practically fifty of these vessels.

It is now time to ask ourselves what success we have attained with these vessels, and what should be accepted as the standard type for performing the functions required for such vessels.

Three years ago a paper on this subject, written by Lieutenant R. C. Smith, U. S. Navy, was published in the Institute; he outlined the practices of the builders abroad at that time, and deduced from them, from the conditions to be fulfilled in our service, and finally from what experience had taught us with the two or three boats already built, that two types of boats were essential, advocating the building of only these standard types; he also pointed out some of the objections that would result from great variety in size and type.

Let us then examine our list of torpedo craft and see if they can be classified into two types. It will be seen at once that any attempt to arrange them according to length, displacement, speed or armament is practically impossible. It is only in the destroyer class, where a batch of sixteen were laid down at one time that there seems to be anything like a standard. In this class we can say that there are sixteen boats with displacement of from 400-420 tons, with horse-power from 7000-8300, and a speed of 30 knots over a 30-mile course. Having set this type to one side as a destroyer class, there remains on the list torpedo-boats from 46-175 tons, intermingled with destroyers from 146 tons to the standard destroyer of 420 tons; speed from 20-30 knots; and an armament of torpedoes and battery with but little more regard to law and order.

It is natural that these conditions have arisen, and far from regretting that such is the case, it may prove to have been of considerable benefit if properly considered.

Some of the reasons for our heterogeneous collection of torpedo-boats may be found dependent upon the following conditions:

(a) It was the desire and policy of Congress to scatter the work throughout the country in order to foster the shipbuilding policy, and to develop the specialty of building small craft. This allowed many small firms that had but little experience in building vessels of this type to bid and submit plans, as it required but a small plant to turn out these vessels.

(b) Besides the variations resulting from the acceptance of plans of the different contractors, other variations constantly arose from practical difficulties met with by the contractors in carrying out the specifications. Some of these, no doubt, were due to lack of skill on the part of the contractors, and others to faults in the Department's designs; others possibly to a desire on the part of the contractor to use a cheaper and possibly equally good design to replace the more costly one laid down by the Department.

(c) Possibly a desire to build experimental types can account for some of the variations.

At any rate we have them; and having them, a close study of the performance of the different types, and their efficiency in the special rôle to which they should be assigned, ought to give us

much valuable information, and lead to the selection of two, or at most three, types of boats that can then be standardized as far as possible.

In order to decide upon these types, information may be obtained from three sources.

First. The practice abroad of the leading powers. Until recently this has been almost the only source from which conclusions could be drawn; so, too, there ought to be a perfect familiarity with the results that are attained abroad with the different types in order to more closely judge the efficiency of our own types.

Secondly. The examination of the performance of our boats during the Spanish war, in which they performed almost every function except the one which properly belonged to them—that of attacking an enemy's fleet. Many important lessons in construction and engineering can be drawn from this source; but nothing tactical.

Thirdly. Consider the strategical points involved as a result of our isolated position, and the requirements for torpedo-boats that are demanded thereby. From this, certain qualities will be found as absolutely essential for one class of boats, and certain others as the essential features of another. Knowing, then, what is to be required of the boat, an examination of the performance of our own boats and of those abroad should enable us to select the type of boat as a standard, possessing such qualities to the highest degree, and all boats should then be required to conform to this standard even to the most minute details.

The advantage of possessing uniform qualities is even greater in its application to a flotilla of torpedo-boats than when applied to battleships. Equal speed, steaming radius, interchangeability of parts, all add materially to efficiency and economy of the boats.

Classification.—Before entering into an examination of foreign practice, it would be well to fix our ideas by the selection of certain standards of comparison. The following classification is based on the displacement as giving the best indication of the sea-going qualities of the boat.

(a) Class O. Destroyers. Boats of high speed over 200 tons displacement; carrying guns and torpedoes.

(b) Class P. Sea-going torpedo-boats (picked). All boats over 150 tons: they are capable of maintaining themselves at sea

as long as there is a demand for their services; though on account of the relatively small number of officers and men, and the cramped quarters, they should be allowed to leave the squadron and return to port when opportunity offered.

(c) Class Q. Sea-going torpedo-boats (questionable). All boats between 100 and 150 tons; these boats are sea-going, but not sea-keeping; two or three days continuously at sea being about all they can stand.

(d) Class R. Torpedo-boats (stationary). All boats under 100 tons. They are properly not sea-going, as there is certain risk incurred in sending one to sea alone, especially for a sufficient distance to prevent her again reaching port before foul weather sets in.

The same letters are used in this classification, by displacement, as are used in the English Naval Pocket Manual (where the classification is by length), by far the most complete and accurate list of torpedo craft now published.

The principal changes from the tables given in the manual are: (1) it reduces very much Class P (sea-going), also known as sea-going torpedo-boats, throwing most of them into Class Q (questionable), also known as first-class boats; (2) it very much increases Class R (station boats). This class embraces all, or practically all, of the boats known as second-class, and some of the so-called first-class boats.

The following table shows the classification more clearly:

Class.	Displacement.	Name.	Loose Classification.
O....	209 and over.	Destroyer.	Destroyer.
P....	150–200	Sea-going, picked.	Sea-going.
Q....	100–150	Sea-going, questionable.	1st class and sea-going.
R....	Under 100	Station.	2nd class, station, vedette.

The Practice Abroad in Torpedo-boat Construction.

In 1878 and 1879, England, Germany, France, and the United States built one or more fast launches of 60–100 feet in length and as high as 22 knots speed to be fitted with Whitehead torpedoes. During the next five years two or three 100-foot boats were turned out by Thornycroft and Yarrow, principally to fill the orders of the leading foreign governments.

Germany.—In 1883 Germany decided upon a type of boat, which was about 125 feet long, 85 tons displacement, 1000 I. H. P.

and 19-22 knots, armed with two H. R. C. and two tubes. In the next seven years she added 63 of these to her flotilla.

In 1892 she built sixteen boats, 144 feet long and 110-125 tons displacement, speed 25 knots; and in 1898 with 152 feet length, the displacement was increased to 140 tons, apparently to obtain greater endurance, seaworthiness and habitability. Her policy until 1898 had given her but two types of boats, sixty-three of the 125-foot length (19-22 knots), boats distinctly for station work; and sixteen about 125 tons (25 knots), boats for operating with squadron.

In 1898 the size increased to 140 tons, and there are now building eight of 155 tons displacement.

Conjointly with the building of these boats, Schichau has built eleven larger boats, known as division boats. They have been added in the proportion of one to each seven boats, and are supposed to be the flag-boats of the divisions as well as to render aid to a certain extent to the other boats. They are between 250 and 300 tons, speed increasing from 21-28 knots, according to the date of building. Only the last of these boats, No. 11, has twin screws; while of the eighty-five torpedo-boats already mentioned, none have twin screws. The armament of these boats, originally two 37-mm. guns, has now been replaced by 3-pdr. R. F. G. and .31 cal. machine guns; with two or three torpedo-tubes, according to their displacement.

There are also twenty boats built by different firms between 1884 and 1887 that are less than 100 tons and have twin screws.

England.—England was conservative as usual. Her pioneer private firms were selling boats abroad before she began to build; but with her liberal appropriations, she has carried the boats forward more completely than any other nation. The history of her policy will consequently be the most instructive.

Starting with 86-foot boats in 1878, she seemed content with watching the results of the efforts of her builders to fill the orders for one or two boats for foreign governments, till in 1885 she ordered the Swift, 150 feet long, as the first attempt to get a sea-going boat. In 1885-86 she decided upon a type close to the type selected by Germany two years before, *i. e.*, 125 feet long with somewhat less displacement (60-75 tons), and ordered fifty-seven to be built at once.

The next year, on account of gradually increasing speed ob-

tained by several firms, she built a boat 135 feet long, with speed of 23 knots. In 1887, Yarrow sold a 140-foot boat, speed 25 knots, to Spain; and Thornycroft a slightly smaller boat, speed 26 knots, to Italy.

In 1893-95, England built ten boats 140 feet long and 100-130 tons displacement, which she tested the next year in her squadron manœuvres; as well as her seventy small station boats about 125 feet long.

These ten were the last torpedo-boats built by her, the destroyer having replaced that sea-going boat for service with the fleet, leaving her ten sea-going station boats of the first class and seventy-five vedettes for harbor defense.

Destroyers.—On account of the unsatisfactory speed of her torpedo gunboats, England, whose rôle is to protect the fleet, ordered (1893-95) thirty boats called destroyers, the rôle being to supplant the gunboat in protecting the fleet from torpedo attack; and further, having sighted the torpedo-boat, to overhaul and destroy it. Thirty were built immediately, 190-200 feet long, 220-280 tons displacement, and 27-29 knots speed. Seven slightly larger boats were built the same year, length 210 feet, displacement running up to 300 tons, and speed to 30 knots.

In 1895, during the squadron manœuvres, these destroyers were tested with such satisfactory results that England has made no addition to her torpedo-boats since that time; but has increased her destroyer flotilla from 50 in 1895 to 118 in 1900. The only change in type being an increased size and power. One of her latest laid down is as follows: Displacement, 420 tons; I. H. P., 9000; speed, 33 knots; armament, one 12-pdr., five 6-pdrs., two tubes and four torpedoes.

Among the tests in 1895 was one to prove the power of the destroyer to catch the torpedo-boat. Without any preliminary notice, twelve of the best torpedo-boats, with a speed of about 20 knots in a smooth sea, were sent at full speed toward port 40 miles distant. After giving them twelve minutes start, the destroyers were sent after them. The chase was over in eleven and one-half miles, and lasted about thirty minutes. Four of the boats escaped, the highest speed logged by them being about 20 knots. Some of the boats broke down, as did two of the destroyers.

Good results with the destroyers were also obtained in firing

at a target when running by at a 30-knot speed, and in discharging the Whiteheads when running from 20 to 30 knots. Experiments were also made as to the ability of the destroyers to block all the boats in port, and protect a fleet passing along a hostile coast. The results of most of the work in 1895 were kept confidential, but an extract from a letter written by a capable naval officer who took part in the operations says: "The impression left on my mind by the manœuvres was that all the present types of boats are obsolete, and that probably no more [like them] will be built. But I believe that boats of the size of the destroyers will take their places in every navy." This certainly has been the policy of Great Britain. In 1896, in addition to the fifty already turned out of 27 knots, she laid down thirty more similar to the seven already noted, of 300 tons displacement.

France.—Torpedo-Boat Policy.

France in 1878 began with an 86-foot torpedo-boat of 30 tons and 19 knots, about like the Stiletto in our service, but slightly smaller. In five years she acquired about fifty of these, and has built no more. When new they made from 16-19 knots. Her vedette boats—13, including 7 aluminum boats of 60 feet and 15 tons displacement—she has shown no desire to increase. The first type (10) she armed with 37 R. C., and on the remainder she has placed two 1-pdr. R. F. guns, and two torpedo tubes. This is now her armament for all boats except her sea-going boats.

While she was building her 86-foot boats, third class, she also (in 1878-83) turned out eighteen 110-foot boats, about the size of the Gwin.

In 1885 she made a large program for accession to her torpedo-boat flotilla, and in the next four years added 60 to this Gwin type though 15 feet longer and of somewhat less beam. All of her boats to this point were second-class boats having less than 60 tons displacement with over 100 feet length. At the same time a program was brought forward for building a certain number of boats of tonnage between 60 and 100, and length exceeding 100 feet. These were to be designated as first-class torpedo-boats.

The type selected had the following characteristics: Length, 134 feet; beam, 11 feet; depth, 7 feet; tonnage, 67, and I. H. P. 700 to give 20 knots with single screw.

From the experience obtained from these boats a new type of first-class boat was adopted two years later, with the following characteristics: 118 feet long, 13 feet beam, 8½ feet draft, 79 tons, 1300 I. H. P., 23 knots with two screws. The modifications in general terms being as follows: adding a second engine of same size, thereby doubling the I. H. P. and giving a speed of 23 knots instead of 20. The boats now being 16 feet shorter, two feet more beam, 1½ feet more draft, on about 12 tons more displacement. This seems to have been satisfactory to the authorities for station work, as they were gradually added until in 1896 there were sixty-four of them practically identical.

In the armament of these boats she has been consistent.

The construction of sea-going boats began in 1889. In 1895 the Forban, built by Norman, led the world with 31.5 knots. During this time she built thirty-four 100 to 150-ton boats, length 140-160 feet, with every apparent variation in speed, armament, and coal endurance, without regard to dates of building. The armament varies from two 1-pdrs. to three 3-pdrs., this last battery being put on the smallest of the class; and the tubes varying from two to four.

Summary.—(*a*) Briefly outlining the results of France's torpedo policy it is seen that commencing in 1878 she built second- and third-class station boats, possessing, in 1885, fifty small Stilettos and eighteen Gwins. She then abandoned her Stiletto type and in the next four years added sixty to her Gwin type, though 15 feet longer and somewhat narrower. At the same time she made her first attempt with a first-class boat, *i. e.*, 60-100-ton boats, and laid down ten resembling the McKenzie, but 34 feet longer and of a little less beam. These were evidently failures; for shortening the length 16 feet, increasing the beam 2 feet, and using twin screws, she has reached her present type which will be referred to as the French station type.

She seems to have been unable to decide upon a sea-going type.

Her present flotilla comprises fifty Stilettos, seventy-five Gwins and ten McKenzies, none of which types she would duplicate. Also sixty-three first-class, and thirty-five sea-going boats of 120-130 tons of questionable sea-keeping power. It may be safely assumed that none of these are capable of remaining and operating with the fleet, but must always rest on a station as a base.

(*b*) Germany seems to have obtained a good type in her sixteen

boats of 125 tons design, their principal objection (a bad one however) is that they have single screws. Any boat required to operate at sea more or less independently must have two engines to insure her safety. A torpedo-boat comes into port under one engine far oftener than is supposed.

(*c*) England's last sea-going torpedo-boats (10) built in 1896, about the same size as Germany's (110-130 tons) boats but with twin screws, were satisfactory, but had not the sea-keeping power demanded by her policy, nor could they fulfill the tactical demand for the destruction of the enemy's boats, called for in her offensive rôle. Hence her destroyer.

France, ever trusting in her ingenuity and theoretical schemes, which lean toward the performance of miracles, has now directed her attention to submarine marvels, after having created an enormous flotilla of small boats practically none of which are sea-keeping.

Conclusion.—From all of this we find that a good twin-screw sea-going, but not sea-keeping, boat can be obtained between 110 and 130 tons. While the destroyer must be over 250 tons, with a tendency to increase its size. England's largest destroyer, the Express, is 420 tons and 9250 I. H. P.

Having looked over the navy list of the leading powers of Europe it is seen that they have quite as heterogeneous a collection of boats as are shown on our own list with the difference that they have large groups of each. This does not mean that they have found a need for each group, but rather that they represent the costly steps leading to present practice. The present practice shows but little variety in types.

These then are the types that foreign practice would lead us to adopt. After considering the information from the other two sources we will compare them.

Secondly.—The Performance of our own Boats during the Spanish War.

As the boats made no torpedo attack, the principal points upon which information can be gathered are, habitability, seaworthiness, sea-keeping power and durability. An investigation of these points will divide the boats into station, and sea-keeping boats; and in addition the destroyer class; a brief record of the performance of the different boats that took part in the Spanish war will be given, starting with the smallest of the class.

The Gwin and Talbot, sister boats of 46 tons displacement, one engine, one boiler, and speed 20 knots, arrived at Key West the middle of July, having come down through the canals as far as Ocracoke inlet. The McKee, a boat of the same class, except that she is equipped with two boilers, came at the same time. About the first of August, in response to the restlessness of their commanding officers, they were sent out on the blockade off the north coast of Cuba from Cardenas to Cay Frances. Their special function was to pass in among the shallow inlets behind the Keys and capture and destroy all cargo-boats, sloops, schooners, and fishermen suspected of rendering assistance in discharging the cargo of blockade runners. The steamers entering these ports could not get up to the towns for lack of water, yet could remain concealed behind some of the Keys till discharged. The Foote and Cushing, 140 and 105 tons respectively, twin screws and two boilers, were also on this expedition. It was expected that large ships of the blockading squadron would be found in the neighborhood; from these supplies were to be drawn, and upon them they could depend for defense from the Spanish gunboats, of which there were several in the principal ports. These parent ships turned out to consist of one or two auxiliary converted yachts that were but poorly equipped with coal and water; and even they were soon separated from the boats. The Talbot having smashed in her bow in a night collision while carrying despatches, the other boats cruised in pairs among the Keys, chasing and capturing all the craft that dared appear, even in sight of gunboats that usually contented themselves with pouring dense volumes of smoke from their funnels upon sighting the torpedo-boats. The gunboats ordinarily lay alongside of the docks, content to be let alone.

On this cruise one of the torpedo-boats, having but a single boiler, was troubled with a leaky tube. So, lying under Piedras Key, she cut out and replaced the tube and brought off in boats enough water from a cistern on that island to again fill the boiler. Just how long these little craft could have remained on this sort of duty it is difficult to say, as any passing vessel could supply them with coal and water and a little hard bread and canned meat. When they returned from the blockade on the 10th of August, the preliminaries of peace having been arranged, they could certainly have remained a week longer without any additional supplies.

These boats then showed their ability not only to operate from a fixed base such as Key West, but also to utilize the larger vessels on the blockade as a base, and efficiently carried out the rôle of shallow draft gunboats in passing among the Keys and suppressing all commerce across the interior waterways, though they were never designed for this work.

Cushing, Ericsson, and Morris. These somewhat larger station boats did not have very much duty during the war. The Cushing and Ericsson saw such very hard despatch duty just before the war as to necessitate very extensive repairs. The Cushing accompanied the other boats on the blockade on the first of August, and stayed out until the boats were recalled from the blockade. The Ericsson, though constantly breaking down, and returning to port, scored a point in being the only torpedo-boat on the scene of action on the day of the Santiago fight. This was due more to the ingenuity, patience, and perseverance of her commanding officer than to any good quality of the boat. The Morris did not arrive till near the end of the war and did not leave Key West.

The Foote and the Winslow went out on the blockade of Matanzas, Havana, and Cardenas at the outbreak of the war. The Winslow's career was about finished on the tenth of May when she was disabled by the gunboats at Cardenas. She had seen several days of service on the blockade up to this time.

The Foote remained on the blockade for about seven weeks, coming in twice for mail and despatches and fresh food for herself and the other ships occupying that station. She was then withdrawn, being relieved by the Leyden. After about two weeks' overhauling at Key West, principally renewing the boiler fronts, she was again ready for work; but was not sent out again till August when she returned to the blockade of Cardenas and ports to the eastward as already stated. She remained there till recalled at the end of the war.

Porter and Dupont. These two boats were at Key West at the outbreak of the war. They went on the blockade as did all the others. But the Porter was then assigned as a despatch boat to the New York, and the Dupont soon returned to Key West, where she was held in reserve by the station ship for despatches. The Dupont made two long trips, accompanying a squadron to Cienfuegos, and going out to meet the New York on another occa-

sion. She was also at Guantanamo at the end of the war. Her record for steaming during the war was about 9000 miles.

The record for stanchness, sea-keeping power, and general excellence belongs to the Porter, which held the record of 12,900 miles of war service, on despatch and blockade duty, without other repairs than those made by the force on board. About the 20th of July she went north for general repairs, and a complete overhauling, her boilers having reached their limit of endurance.

Thirdly.—STRATEGICAL AND TACTICAL DEMANDS.

The West Indies has ever furnished a battle-field for naval wars; and so will it be in our next war. The importance of being able to control its waters will be doubly accentuated by the need of controlling the Nicaragua canal.

Destroyers.—The fleet of battleships must be maintained in these waters, and their safety from torpedo attack by the enemy must be insured by the destroyers. So that a flotilla of these in the proportion of two for each battleship would be a fair allowance. They must possess the speed sufficient to catch a 25-knot torpedo-boat, and the sea-endurance to remain with the fleet without being a constant source of anxiety to the commander-in-chief. A small, but powerful battery, and comfortable quarters for the crew are the essentials. Two torpedoes furnish a sufficient armament to give all of the moral effect of the torpedo-boat. Moreover two torpedoes carefully fired would be as good as half a dozen.

Sea-Keeping Torpedo-Boat.—In addition to this flotilla of destroyers associated with the fleet of battleships, the commander-in-chief needs an offensive weapon that can be used against the hostile squadron which may be operating in some portion of the West Indies or which is making a feint at some point along the coast. This may be only a detached squadron; yet something must be done to meet it.

Twenty sea-keeping torpedo-boats such as the Porter can be made to cover long distances at good speed, without being seen; make an attack and disappear, leaving the enemy in such a demoralized state that they will fall back on their base, or at least withdraw from that vicinity. Their employment as mounted infantry and light artillery combined would in the hands of an energetic commander-in-chief be most demoralizing.

Station Boats.—Turning next to boats of limited endurance

which should be classified as station boats, they can be tactically classified under two heads. (*a*) Sea-going, capable of continuously operating for two or three days at a moderate distance from the base. To this class belong the Cushing, Ericsson, Morris, and even the Winslow. They are capable of selecting any point on the coast as a base, and can be rapidly mobilized at such point if scattered along our entire coast-line of a thousand miles.

(*b*) Station boats whose operations are practically limited to a single night's attack, designed as a part of the coast defense system, operating through the inland waterways from Lake Erie and Buzzards Bay to Fernandina, Fla. Boats of this class are the Talbot and the McKenzie, the Cushing being almost too large for such work. The number of these boats required should be sufficient for the defense of Massachusetts Bay, Narragansett Bay, New York Bay, Delaware Bay, Chesapeake Bay, Charleston, Galveston, San Francisco Bay, and Puget Sound. A pair of these boats at each of these points would give a certain feeling of protection to the people, and liberate more valuable and powerful vessels for offensive operations. With the ten monitors now complete or building distributed at these same points, the Secretary of the Navy would be able to give a satisfactory answer to the clamor for local protection. In the case of imminent danger at any point on the coast this force could be concentrated to resist such attack, though this movement could not be rapidly effected. We already have the ten monitors which are especially fitted for this rôle; and the cost of sixteen more Talbots would be about one-fourth the price of one battleship.

Having now examined the three sources of information we can apply our knowledge to the selection of types having due regard to the rôle which each type will be called upon to play in actual war.

In order to have present practice abroad in a readily available form the following table has been arranged which is fairly accurate, the conflicting statements of the different sources of information upon this subject making it very difficult to obtain correct data.

Nation.	Type.	Built.	Building.	Displacement.	Length.	I. H. P.	Speed.	Armament.
England ..	Destr.	108	10	300	210	6000	30	1 12-pdr., 5 6-pdr. 2 T.
	Boats	98	..	...	...	..	..	
France. ..	Destr.	4	8	300	185	4800	26	1 9-pdr., 6 3-pdr. 2 T.
	Boats	211	8	152	144	4200	30	2 3-pdr. 2 T.
Russia....	Destr.	1	28	240–350	196	3800	27	3 1-pdr.
	Boats	174	17	120	...	..	..	
Germany..	Destr.	1	5	350	210	5800	28	5 3-pdr. 3 T.
	Boats	113	9	155	157	2500	25	1 R. F., 1 mch. 2 T.
Italy	Destr.	..	8	320–350	196–208	6000	30	1 12-pdr., 3–5 6-pdr. 2 T.
	Boats	142	2	150	156	2700	25	2 1-pdr. 2 T.
Japan	Destr.	..	8	275–300	220	6000	30	1 12-pdr., 5 6-pdr. 2 T.
	Boats	44	12	130	148	2000	26	2 3-pd.
U. S..	Destr.	..	16	420	245	8000	29	2 12-pdr., 5 6-pdr. 2 T.
	Boats	20	11	165	175	3000	26	3 3-pdr. 3 T.

Requirements of Destroyers.

Speed.—The boat must have sufficient speed to overhaul a torpedo-boat and disable her. It is well to remember that at night the discovery will be made at close range, and but a slight superiority in speed will be sufficient to enable the destroyer to close sufficiently to prevent the boat from eluding her, and enable the gun captain to hit his indistinct and difficult target. The flare from the stack of the fleeing boat, when she is pressed to her limit of speed will materially assist the destroyer unless the rain, snow, or fog intervenes. In daylight the discovery of the torpedo-boat is not likely to be made at more than five or six miles, so that a difference in speed of three knots would give the destroyer the necessary superiority. A speed of 28 knots that can be maintained for six hours is sufficient for all purposes, and gives a surer indication of the value of the boat than a delusive 32 knots with bottled up steam over the measured mile. To attain this result

the machinery must not be shaved too light. The results of the performance of some of these boats abroad during the last year indicate that the factor of safety is too small, and that the number of revolutions allowed is beyond safe practice, making the strain on the moving parts tremendous; any slight flaw in forging or tempering, and the engine room is a wreck—if there is no worse result. Let us not be carried away by the desire for the fastest boat in the world. Moderate revolutions and steam pressure and stanch machinery, and we can challenge the speeds shown in the table and feel that we have the better boat.

Armament.—Five 6-pdrs., one 12-pdr., two tubes and two torpedoes.

The argument in favor of this battery is found under the head of Criticism on Ordnance.

From the table it is seen that our armament is still the equal of any nation, and superior to most, except in the number of torpedoes carried on board. It is well to bear in mind that some of the boats do not in practice carry *both* torpedoes and guns; one or the other is left ashore.

A liberal allowance of coal and water must be carried, remembering that at night the boats must be actually cruising. During the day by running slow under one engine and carefully tending the two large distilling plants that are needed she can replenish her water supply. In case of necessity coal and water can be supplied from the big ships such as the New York, and the distiller ship; but it is best to be self-supporting as weather and unusual circumstances may make assistance impossible.

Displacement.—Before deciding upon the size it is well to bear in mind the two distinct rôles in which the destroyer appears.

First. She is a terror to all torpedo-boats; her powerful battery, relatively high speed in all weathers, and shallow draft leave them but little hope for escape, unless a lucky shot at long range disable her. In this rôle she acts as the night policeman for the fleet, easing the nerves of the battleship.

Secondly, and this is a point that is likely to be forgotten, she is a terror to the enemy's fleet; for not only does she carry the same torpedoes, and will appear from more distant points, but she still retains that essential element to successful attack by surprise, a relatively small size and consequent invisibility. It is the failure to recognize this essential quality that has led to the advance-

ment of a type of boat of 600-800 tons displacement, which is based on the sound doctrine "the bigger the better" when coal endurance, stanchness, comfort, and speed are the qualities desired. The "long low rakish craft," this invisible terror of the seas, must be retained, as in the piratical days of old, to destroy a few and strike consternation to the hearts of all.

We have reached the happy result, but the outside limit, in our 420-ton destroyer. It is well to remember that foreign practice tried this 800-ton boat several years ago in their "avisos" and scouts, which were afterwards abandoned, and then developed the torpedo-boat to its present size. By examination of the table it will be seen that even now we lead all other powers in the displacement adopted.

Torpedo-Boats, Class P.

Requirements.—Only sufficient speed is needed in vessels of this class to make it possible to overhaul and attack a distant fleet cruising at a moderate speed. Twenty knots is thought to be a good sustained speed for an all-night run in moderate weather. This would give a 25-knot speed for the dash to escape after the attack. A boat that can be relied upon to do this should be able to maintain a speed of 25 knots for six hours in smooth water.

A flotilla of these boats would temporarily accompany the squadron till the commander-in-chief decided upon the point of attack, or received information of the enemy which would permit a blow from this mobile arm of his fleet. After the attack the flotilla would probably return to the nearest base. They are expected to join the fleet whenever needed, and to remain till the attack has been pressed home. But the admiral would leave them resting on a convenient base till the time seemed ripe for the blow.

The armament thought best is three S. A. 6-pdrs., two tubes, and two torpedoes. The reason for this selection is found under Criticism on Ordnance.

Displacement.—The displacement must be kept as small as is consistent with sea-keeping power. These boats must be able to keep with the squadron through all weather; and have a crew, coal, and water sufficient to be counted on for a week, and still

be able to return to port. The Porter seems to have been able to fulfill these conditions under the test of war; yet no smaller boat seemed to be able to come up to this requirement, so that 165 tons seems to reach the sea-keeping power combined with a size that permits of a successful surprise in a night attack. Great Britain alone has recognized that boats of a smaller type than this fail to attain this sea-keeping requirement. She reported adversely upon her largest torpedo-boats in 1896, and since then has built nothing smaller than the destroyer. The table shows that France and Germany are trying 150-ton boats, their first venture in boats of such great displacement, France, alone, with her desire for the marvelous, stipulating a speed of 30 knots. Twenty-five knots maintained speed answers all requirements. The table shows that for our 165-ton boat the armament is superior to that of any boat abroad; but three 6-pdrs. would make her a Tartar for destroyers and small gunboats.

Station Boats, Class Q.

There does not seem to be any need for this class in the scheme for coast defense, and they are not sufficiently powerful for offense. So that though the ten that we have thus far acquired are quite useful for drills and exercises in our home ports, and will make good station boats for the West Indies, there seems to be no reason for duplicating any of the six types represented by the ten boats in this class.

As for the Manley no one seems to know for what she was designed or why she was bought. Possibly it was to give us wrinkles in design and construction. This was a reason that I heard advanced for the purchase of the Somers. This boat, 150 tons, has but a single screw, and when the attempt was made to bring her over she leaked so badly as to require her return to port. After the war she was brought over in a freight steamer. She has the lines typical of all the Elbing boats. She carries an underwater bow tube, which may have been the cause of her trouble. At any rate Germany has lost three boats by foundering at sea, and it is thought that they were on these lines, though smaller. In the latest sea-going German boats there is no submerged bow tube and no forward conning tower.

2

Station Boat, Class R.

As already stated, twenty boats of the Talbot type, with a 1-pdr. forward and a machine gun aft would cover the conditions for the defense of the waterways and harbors.

Having decided upon our general type let us examine the details of construction, equipment, etc., on board our boats to see if they have stood the best test of their value, viz., satisfactory results on boats in commission. This examination will be taken up according to the classification by departments on board ship. The writer is encouraged to make this minute and detailed examination by the generous desire shown by the bureaus concerned to make the changes suggested and remedy the faults where a remedy could be pointed out.

Detailed Criticism and Comparison of Certain Points in Construction.

In no way is the difference between an experienced builder and the novice so evident as in the details of hull construction, and its fittings, and in the use of some little device learned by experience, which often adds materially to the efficiency and comfort of the boat.

Consequently, the writer does not believe that any detail is too trifling to criticise, especially if a remedy is easily found. A striking example will first be given to illustrate the point, before going into an enumeration of details.

A large ventilator was placed over a cabin in order to give fresh air to the sleeper. The result was a wet bunk all the time; at sea it was salt water; in port, rain or sweat from the plate on the inside. In practice the bottom of this ventilator was kept tightly closed by a plate, and a canvas hood placed on the outside when going to sea.

Ventilators.—Experience would indicate that all attempts to ventilate compartments by means of small ventilators are failures. The discomforts and damage inflicted by salt water and rain more than offset the possible advantage of these few small air pipes. The only exception to this is for the compartment containing the closets, where there is usually little to spoil by salt water.

With this exception, there should be no opening in the deck

from one end of the boat to the other except hatches and coal-bunker scuttles. The hatches should be arranged with some device allowing them to remain open and yet keep out rain and spray, even though occasional seas sweep on board.

On one of the boats of the Winslow type, canvas hoods were fitted over the hatches of the principal compartments (*i. e.*, the living spaces and the engine-rooms), which were lashed around the hatch coaming and carried up about two feet, and the opening left on the lee side. These were only put on in bad weather. An excellent device is found on some boats. The hatch-hood is a quadrant of a cylindrical section, one side fitting over the hatch, and the other open to the air, ordinarily looking forward. The upper half of the periphery opens or closes by a sliding shutter. Shutters, either sliding or swinging, can also be fitted to the side that looks forward.

The advantages of this arrangement are that: (1) In fair weather the sliding top can always remain open unless the sea would enter a hatch with 18-inch coaming; (2) in falling weather, by hauling over the sliding shutter at top, and shifting hood so that the side opening looks to leeward, no water will enter. In ordinarily good weather, with sliding shutter on top hauled back and side shutter open, entry and exit are in no wise impeded. With an ordinary cowl the hatch cannot be used for this purpose. This hood of course having a rectangular base, has only four positions, abeam, and fore and aft; but its efficiency seemed little reduced thereby; while its usefulness in all weather recommends it greatly. They should undoubtedly be fitted to each living compartment, and seem to be equally adaptable as hoods for blower-engines in firerooms. When fitted over blowers they should have light wire screens, say a 2-inch mesh, to prevent signal-flags and wash-clothes from going into the blower.

Each living space should have two openings, to facilitate exit and also to give proper ventilation. For the two principal spaces, the cabin and the crew's space, the conning tower can be utilized for one of these, and a hatch, as above described, for the other. If an old-fashioned windsail is then rigged in the hatch or tower, as best serves, a good supply of air will be insured in these two compartments in practically any weather, a condition that has often been denied our boats. A scant supply of air at 115 degrees, and that mixed with salt water, will lay

low the toughest mariner, and result in a short time in a disabled crew and boat. Few of the boats during the war, when subject to these conditions, could boast of a man who had not been seasick.

The air ports on the sides abreast the living quarters are very convenient, and, when reasonable care is taken to renew the gaskets when softened by heat or oil, are satisfactory.

Referring again to the ordinary round top cowl or hood, an objection to it was noticed which may be new. When a man is feeling his way along the deck at night in rough weather and has seized the rim of the cowl, instead of getting support from it, the cowl, revolving from his weight, has sent him stumbling against the rail with the roll of the boat; on one occasion the cowl came off and the man was with difficulty saved from going overboard.

Clear Decks.—While on this subject of ventilation and deck openings, too much stress cannot be laid upon the necessity for clear decks. There should be no openings in the decks except for the blowers, the passage of men below, the coal scuttles, and a large hatch over each engine. All these, when closed, should offer an easy gangway for travel fore and aft. Especially should this be true of the coal scuttles and engine-room hatches. A satisfactory scuttle, flush with the deck and reasonably tight when cared for, is a rectangular brass plate held down by dogs against a rubber gasket fitted in a score around scuttle. A passage along the decks of some of our boats on a dark night is at the imminent risk of going overboard, to say nothing of the condition of shins which is sure to exist as a result.

Deck Covering.—After a good deal of experimenting on the suitable covering for the deck the choice now seems to lie between linoleum and gratings. The most satisfactory result has been obtained by laying gratings along the line of traffic fore and aft, and holding them down by movable cleats, so that they can be taken up without much trouble, and yet will not wash overboad in a sea-way. In case of abandoning the boat these are useful as life-rafts, as they can be loosened in a moment.

The only advantage possessed by linoleum over gratings is a reduction in weight, and this is not great; its disadvantages are: (1) lack of durability, being easily punched full of holes and

torn around the edges; (2) difficulty in securing it to the deck, as on any other than flat deck boats the first sea will catch under a loose edge and rip up a whole sheet. It then requires a dry, warm day to stick it down. Also, if water lodges under it, the deck will rust badly. Then, over the fireroom, the different coefficient of expansion of the linoleum and steel will always loosen those sheets.

Linoleum has been satisfactorily used as follows:

On the Talbot class by holding the strips over boiler-room down by one-quarter inch strips of steel along the edge secured through the deck by round-head stove bolts. This system could be applied throughout, using galvanized iron or brass strips on the edge of each sheet of linoleum, and holding it down with screws through the deck.

On the Winslow, which type, being turtle-back, have given the most trouble, a sort of combination of grating and linoleum has been adopted. Wooden strips, 3 inches wide and 3 inches apart, run fore and aft, held down by screws; under these wooden battens are linoleum strips. The arrangement prevents slipping, but as the foot finds no complete support either on the battens or between them, it would soon become disagreeable and tiresome when one moves about the deck. Rubber matting, which has been tried on some boats, is not only soon broken to pieces but is actually heavier than the grating.

Below Deck.—Below decks, the floors in the living spaces should be of hard wood. In the cabin compartment a covering of thin linoleum tacked down on some light wood, as soft pine, works well; when given a coat of shellac once or twice a month, this gives a durable floor, easily kept clean and dry in all weathers. In the crew's quarters a coat of shellac each week applied to the bare hard wood, gives the best result. All this wood should be soaked in paraffine or electro-proofed to prevent absorption of moisture from the bilge and swelling, so as to make constant misfits of the movable hatches. As electro-proofed wood is said to cause corrosion of steel, the edges of the floor that come in contact with hull should be oiled or painted to prevent such a result.

More permanent discomfort has existed on board the boats from a failure to give a thin canvas lining to all living spaces than from any other cause.

In the Cushing, which in her early days boasted four officers in her cabins, icicles hung from the " roof " in the morning, and rheumatism was common. To remedy this an inner lining of canvas was fitted, leaving an air space the depth of the frame between it and the deck. This probably reduced the sweating, and any moisture that was precipitated ran down the side behind the inner lining and then into the bilge. On some boats where this lining was fitted, the outboard side of the men's lockers being the skin of the ship, the streams trickled into their lockers with the result of wet clothes and more rheumatism.

On the vessels of the Winslow type the men had to sleep under rubber blankets until linings could be fitted. Very thin boards have been used at the side instead of canvas, but this raised the objection of splinters from a shell. The canvas is neat, light, and durable.

While on the subject of inner lining, it is well to say that this offers additional hiding-places for the pest often brought off in wash-clothes; but it has been found that the use of Persian insect powder every two or three weeks, closing up the compartment tight for an hour while the powder was being sprayed, was not only a prevention, but a cure for all crawling creatures.

Living Space Steam Heat.—Here again has experience done much toward securing a system and arrangement that have added greatly to the comfort on board the boats. The most remarkable arrangement was a case where the radiator in the cabin was placed at the highest point of the bulkhead. This would give in cold weather a temperature of 90 degrees at the overhead deck and 30 degrees on the floor. If there was any ventilation at all the occupant always enjoyed the temperature of the outside air, even though it was 20 degrees.

By the simple arrangement of carrying a 1½-inch pipe along the floor close to the lockers, the ventilation and heating are easily arranged. This position of the pipes also assists in keeping the lockers dry. It is well to always have at least one more steam-pipe parallel to the first, extending a part or all the length of the other, with a valve at each end; by this means additional heating surface can be thrown in for severe weather. On the Cushing, by this arrangement, from one to four pipes could be used as desired; after they were installed she was always comfortable.

A radiator is a source of discomfort. It is like a red-hot stove in a small dining-room. The one who sits next to the stove roasts, and those further away freeze. The crews, on account of the size of the compartment, are always at the table.

In connection with the steam-heater pipes there must always be an efficient steam trap intelligently tended. Ignorance on the part of the man on watch in the engine-room is often a cause of cold steam-pipes banked up with water.

Sinks, Basins and Closets.—The closets are, generally speaking, as satisfactory as under-water closets can be. Occasional trouble is experienced from ignorance in the use of the valves and carelessness in throwing waste and similar objects in the bowls. A good safe practice, however, has been to shut off the sea-valves when underway for many hours, if the weather be rough, and not depend on the interior valves for controlling the water. When the closet is used the valves can be opened temporarily, and again closed. The use of proper closet paper is a necessity if the closets are to be kept in order.

The pantry and other sinks should all be fitted with an automatic valve, such as rubber ball, etc., to keep the pipe closed from the sea, opening only by pressure of water from the basin; otherwise the water will boil up into the basin when at sea, and a precious pint of fresh water be converted into salt by the lifting of the stopper in the basin. In the Winslow type, when at sea, it was always necessary to put permanent plugs in the bottom and overflow pipes, and then bail out the water after using, making it much more inconvenient than a tin basin and pitcher would have been. Needless to say, the automatic valve should be easily accessible, to examine and take out the stray articles that are sure to find their way into the pipe and stop it up. Especially does this apply to valves for the closets.

Living Quarters. Position.—The arrangement generally adopted for officers, and if there is space, petty officers, forward, meets with best results. The place of the officers, especially if there is but one, is by the wheel, which can only be attained by placing his cabin near it. As the steering is all done from the forward tower, this reason alone is sufficient for the officers' quarters remaining forward. As to the comfort, it is in many cases an open question, as the heat from the steering engine and fire-room is often intense, the ventilation in a rough sea is almost

nil, and the quarters are often drowned out. The advantages are, ordinarily, less cinders and dirt, and less vibration, though these conditions are not always true. It is important, if possible, to have the chief petty officers separated from the crew.

Tables.—The solid table, that is, one with the sides closed in so that it is stowed completely with crockery, tableware, war-heads, etc., is most satisfactory, being fitted with a leaf on one or both sides to permit a free gangway. Swinging and folding tables have been tried on several boats and have always proved unsatisfactory. They are troublesome to set up, unsatisfactory to eat on, and bulky to stow away; moreover, a table is in constant use all day long, and is a great convenience as a temporary receptacle for charts, books, bundles, writing-desk, and a thousand other purposes at all times. I recently noticed that the crew of a certain torpedo-boat took all their meals squatting round on deck; upon going below I found that the boat had been fitted with a swinging table that was stowed away in a corner and never used.

Chairs and Stools.—The best and most efficient are the simplest camp-stools of light design without backs and seats covered with canvas. These can be scrubbed and kept white, or given a coat of shellac or paint as is most practicable. About the best chair for comfort, compactness, and durability is the cheap steamer chair, made of two crossed pieces on a side, holding in varying positions a strip of canvas.

Ice Chests.—Many have been the makeshifts for this exceedingly essential fitting, which seems to be an afterthought. Starting with the Cushing, which utilized a hard-tack can, and continuing to the Winslow, which had a wooden box perched on the rail, exposed to the hottest rays of the sun and the all-penetrating salt spray, the best result has been obtained in the Talbot class, where a compact, light and serviceable ice-chest is built to the shape of the boat alongside the pantry. The additional supply of fresh food that can be carried with a properly equipped ice-chest adds materially to comfort, and the reduction in the mess bill is also considerable.

Bunks.—The system of bunks for the crew, two tiers, sleeping-car fashion, with pipe frame and laced canvas bottom, are excellent, being light, clean, and dry.

The upper berth system of the Pullman car seems on the whole

to combine the greatest number of good features for the officers' quarters. This is a transom that folds against the ship's side when closed, and when made up swings out about 30 degrees, being held out by straps below. The bunk bottom, a canvas sheet, is fastened along the upper side of this transom, and is held out taut, and the mattress laid on this. It is comfortable and dry, because, except when in use at night, it can be closed up tight. Whereas a bunk that stands open may catch the unexpected sea or rain squall; and a wet bunk—there is nothing worse!

Officers' Quarters.—There has been a great variety in the arrangement of bulkheads, pantries, closets, etc., in the space allowed for officers' quarters, the idea most prominent apparently being to give each officer a room to himself. The result is a series of little cuddy holes, no one of which is habitable; whereas the same space with only one or two divisions would give quarters easily ventilated, reasonably cool and dry.

Taking the worst results first, there is on the Winslow ample space provided for living quarters; but analyzing it in detail there is not a comfortable spot in her. The captain's state-room, a separate compartment furthest forward, has a fixed bunk placed under two or three small ventilators, that will usually either sweat or leak on his bunk according to circumstances. The next compartment, the mess-room, has two transom bunks which are so low that the spray that comes in from the hatch overhead means no ventilation or a wet bunk, if the sea is at all rough. The closet is next, in a small compartment by itself. Abaft this on the port side a fixed bunk, with standing room alongside it; there is not room to sit down and undress, this being done by sitting on the bunk. On the opposite side in another compartment, two wash basins, fixed, for one officer; abaft this in another compartment, the pantry. In passing it may be remarked that the food was always hot, as the pantry was very small and separated from the fire-room by a thin bulkhead it served as a satisfactory oven to every one except the occupant, the steward. A space amidship between the pantry and washroom on one side, and the state-room on the other was useful only in admitting the ladder which occupied nearly as much space as the state-room alongside of it.

A great improvement could be made in this arrangement with but little expense. Considering the entire space abaft the mess-

room, all partitions should be removed, and the arrangement of the floor space be as follows: on the starboard side aft, the closet and one wash-basin should be placed, the latter some small compact type, instead of the enormous aluminum one now in use. This compartment could be cut off by curtains or low partitions from the remainder of the space. If partitions are used they should only be about seven feet high, the angle irons running up to the deck overhead to prevent vibration. The remainder of the space would make a comfortable room. Below the hatch a vertical ladder would be secured to allow passage when necessary, but the main gangway would be through the conning tower. The hatch in the conning tower should be larger and more convenient ladders fitted.

The simplest and most satisfactory arrangement of officers' quarters would seem to be two compartments, one for each officer. The junior officer's room would contain two Pullman upper berths, placed well up on the side with a transom seat below each. This would also be the mess-room. The pantry would be placed as convenient, near or in this compartment. The senior officer's room would be the next compartment preferably abaft this, with the bath-room containing the closet and basin, and usually a fixed bath-tub, set off in a corner by a low partition and curtain.

The old idea of giving the captain complete seclusion from his officers, when carried out in a torpedo-boat is absurd; and he often has roasted or steamed in his effort to get rest in his own cabin; or else occupied his junior's bunk until time to go on deck and relieve him for a six-hour watch.

Of the two compartments contemplated, the captain should have the more comfortable one, and it might vary in the different boats. But in one should be the mess-table and in the other the baths, basin, etc., cut off by a low partition; the pantry being worked into the one or the other as the plan permitted. If these two compartments are separated by a low bulkhead amidships which could go all the way to the overhead deck toward the sides, ventilation through the hatch in the after one and the conning tower in the forward one would ordinarily be good.

In general each conning tower should admit to two compartments; that is it should be supported on the water-tight bulkhead with ladders down each side of the bulkhead. In case the com-

partment on the side forward of this bulkhead is a living compartment, *e. g.*, the mess-room, there should be a hatch with a reversible square ventilator hood, water-tight, fitted over it. This could face to leeward at sea except in exceedingly rough weather when it would have to be closed.

If a deflector running down 18 inches or 2 feet were fitted on the inside of a hatch nearest the bunk, desk, etc., it would often be a great protection and comfort. In good weather this could swing up against the deck and in rough weather by swinging it down in prolongation of the lower side of the coaming it would so deflect spray, etc., as to permit the hatch to remain open. For the same purpose air-ports on the side should have a ¼-inch lip around their upper semi-diameter to deflect the water from the deck above, thus preventing it from entering the port when washing down, or during an ordinary rain.

Boats of less than 100 tons should have but one large compartment, with an addition for pantry, closet, etc.

The Talbot class is an excellent example of arrangement of quarters for boats of this class. The only improvement that could be made would be a double fire-room bulkhead, and a hatch at the after bulkhead. At present the hot air from the fire-room bulkhead banks up at the after end of the cabin and remains at 110-120 degrees. In cutting a hatch it should be so located that no tables, desks or bunks are close under it, as a moderate amount of rain or spray down the hatch is accepted rather than close it, unless the damage to objects close by demands that it be closed.

The Morris having the most recently designed arrangement of quarters is very good, the principal drawback being that they are still too much cut up, too hot, and not well ventilated. By moving back her steering engine about two feet, and shifting her pantry to the starboard side, a free circulation of air could be obtained from the after state-room to the mess-room. This would allow the raising of the mess-room floor and lowering somewhat the cabin state-room floor; then by removing the wooden bulkhead between the state-room and mess-room an excellent airy room would be obtained. A curtain could be run across the forward end to be used when the bunk is made up. A hooded hatch at the after end of the junior officer's room and a hatch fitted with water-tight cover placed at the forward end of the captain's state-room would add materially to the comfort and make the

ventilation nearly perfect. In these boats the petty officers' quarters are abaft the officers' quarters and forward of the forward boiler. There is but one hatch. This ought to be fitted with the square top ventilator described as fitted on the Talbot. On some of these boats a sort of temporary hatch hood has been erected similar to this ventilator to keep out rain; but it is flimsy and cumbersome, and does not work except in port.

There should always be a double bulkhead between the fire-room and the living quarters with a lining of asbestos, or else an air space.

A double bulkhead with an air space would materially reduce the temperature in the cabin. This air space could be ventilated by having several small holes near the bottom of the after bulkhead, *i. e.*, the fire-room bulkhead and one at the top, the latter to be controlled by a shutter from the cabin so that it could be opened and closed at pleasure. A pipe to be fitted at this upper orifice to run along under the deck and open at a convenient height in the outer casing of the smokestack. The air in the fire-room would then be driven by the blower between the bulkheads, and then between the smokestack and its casing, thus serving the double purpose of keeping the cabin and the outer stack cool. The amount of pressure thus lost from the fire-room could be regulated by the cabin shutter, even to shutting it off entirely when highest pressure was desired in fire-room. A few holes could be cut at the base of the outer casing if desired; but in five of our boats the casing is kept cool by draft from fire-room blower through small apertures over uptake. These cannot be regulated, however, and help in no wise to cool the cabin.

This scheme would greatly benefit the living spaces in all the boats. An additional device which would add greatly to the comfort of many of the boats would be to have a similar hole in the top of the forward one of the double bulkhead, and a pipe leading from this to the floor of the next compartment, or even under it. In cold weather this would render excellent assistance in heating and ventilating the living quarters. Then too, at sea in bad weather this would give excellent ventilation.

Crew's Quarters.—The best arrangement yet devised has been attained in the quarters of the Morris. The four chief petty officers are forward; the remainder of the crew are arranged in two compartments aft, the entrance to both being through the after

conning tower. Practically all of the deck force is in the after one and the engineer's force in the other. The conning tower is oblong and contains a long narrow platform deck, supported by angle irons at the side, but leaving room for ventilation. This gives a nice dry place for the men in bad weather, and still ventilates both compartments. Forward of these two compartments is the galley with the closets and bath-room at one side. The galley should always have an opening into the crew's quarters. In one boat the only opening from the galley was to the deck overhead. No cook could stand it for long at a time, especially at sea, with the side air ports closed. Then too, with the cook to serve the table, the hoisting of the meals up one hatch, and then down another was a great source of inconvenience. By putting a windsail down the hatch there may always be a tolerable temperature, if there is an opening into the next compartment. The after conning tower being especially valuable for the purpose of ventilation should be large, oblong, and of very light material to keep down the weight.

Deck Fittings and Equipment.—Running around the boat at the height of her deck, or at the turn of the whaleback should be a heavy wooden guard to take the bumps unavoidably received from the decks, big ships, etc. This saves the bending and dishing of the thin steel side-plates. There should be nothing projecting beyond this guard, either above or below. Iron steps riveted on the sides of the boat are an abomination; they catch against the piles alongside of a dock, or cut a hole in a neighboring boat, when entering a slip, they serve no useful purpose, as the boats all have portable sea ladders.

The best deck railing seems to be a solid soft steel stanchion with three rows of wire about 1¼-inch steel galvanized. The advantages of solid stanchions are that they are neater, stand more bending, can be easily straightened, and are just as light as the hollow pipe stanchions. The stanchions should be held in the sockets by composition pins, kept well coated with black lead and tallow, and unshipped frequently to keep them working easily. Neat slip hooks can be fitted to both ends of the lengths of wire to keep the rail taut.

Boats.—The boats supplied to the Winslow type give excellent service. One is a wooden wherry, nicely finished, ordinarily for the officers use; and the other a metal boat, slightly larger, fitted

as a life-boat with air-tanks running the length of the boat on both sides, under the thwarts. These tanks were punctured by accident at first, but a protecting board was run the length of the boat just over them so that heavy objects would not strike the air-tanks. The boat withstood many hard knocks during the war and proves very useful. The wooden boat had several holes punched in her at different times, but was repaired with a lead patch each time. Besides its greater durability and its buoyancy (owing to the air-tanks) the metal boat possesses the additional advantage of not splintering. This is important as the torpedo-boat would hardly part with her last boat; yet it must remain on deck in close proximity to a gun, or a torpedo. If the boats were fitted with a spritsail, and a rowlock at the stern which could be utilized for sculling, or for a steering oar, it would add to their convenience, and might in case of abandoning ship be a vital necessity.

The folding boats, possessing no good qualities, should be condemned.

As the number and size of the boats supplied are inadequate to carry the entire crew, a life raft must always be devised to carry those unprovided for. If the boat has gratings on her deck these can be utilized. If the boat should go down suddenly there would still be time to loosen and throw overboard gratings that would support the men. If a man also have on an inflated life belt he could survive many hours unless the water was too cold. If there should be time for preparation these gratings can be systematically built into a raft, and several empty deck chests placed on them to keep the crew partly out of the water.

In boats which are not fitted with gratings the experiment has been tried of having the deck chests water-tight, being fitted with tongue and groove lid, and rubber gaskets. On the outside a half dozen life-lines are fitted to be passed under the men's arms and secured. It was found that a moderate size deck-chest would support six men keeping their heads well out of water.

The life buoys fitted usually consist of three or four circular cork buoys, stopped along the rail about the forward and after towers, where most convenient. They are satisfactory in daylight, but lack a valuable point for night work; since there is no port fire to indicate its position after being thrown overboard. Several years ago a small cylindrical can fitted with calcium phos-

phide, and similar in a general way to the marker used to indicate the position of a Howell torpedo, was designed and fitted as an attachment on one of the torpedo-boats; it worked well but seems to have been abandoned in the equipment of the later boats. Objects on the surface of the water can only be seen a very short distance from the low deck of a torpedo-boat, and the chances of a man overboard at night are slim enough already, without reducing them to a minimum by discarding an apparatus that at least showed his approximate position.

At least two deck-chests are a necessity. One of these would be used for alcohol, and turpentine, or kerosene, and the other for deck fittings and equipment and deck gear of all sorts. It is usually bulging to bursting, and if room can be found for these chests, and a third one to be fitted on one side for a complete outfit of tools, it would add greatly to the convenience of the boat. In this respect the Winslow type was very well equipped. A kerosene can may usually be snugly placed in wake of a conning tower, leaving room for some paint in the alcohol chest. Heavy strap hinges should be fitted to the lids of the chests, with clinched fastenings; the ordinary door hinges with screw fastenings last only a few weeks. These chests should be small enough to go down a hatch so that they can be sent below in clearing ship for action.

An important accessory which has been added to many of the torpedo-boats after they were commissioned has been a shelf, usually just forward of the after conning tower, to which a vise could be secured for bench work. As there is a great deal of this work required on board it is necessary that a comfortable place for the work be found, if possible. The bench can be unshipped and sent below in clearing for action.

A vegetable locker of some sort is needed on deck; a perforated soap box will answer for a small boat; but the boats over 100 tons need a fixed, well-ventilated box placed aft where least in the gangway. The position on the Winslow was good; though projections from a dock or vessel would damage it slightly.

Mess and Chart Table.—A very light table with folding legs that could be temporarily placed on deck in good weather often furnishes a refreshing spot to take meals when the quarters below are very hot, or when underway with but one officer on board, and where the navigation would not admit of his absence from

deck for a sufficient time to eat a regular meal. By utilizing a signal mast or a torpedo tube as a point of support, a light board with two folding legs will give a very satisfactory mess table. This can be used for a chart table if the weather is fine; but if it is bad the officer will be driven back toward the after tower, or even in that tower. A small folding shelf with a rack alongside, fitted in the after tower is always useful as a place for log book, charts, books and other aids to navigation, and is often the only dry spot accessible from the deck. At sea in heavy weather all of the navigation is done from this end of the boat. If the charts that are to be employed on the run have all of the courses laid off, the bearings of the light-houses and principal points, from certain convenient points along the track, and the distances laid off at five mile intervals, the chart can be folded and held in one hand, and the position of the boat approximately located without using the chart table. When accurate position is required it can be plotted on the table in the after conning tower or taken down in the cabin. The heavy glass-covered chart tables placed on some boats are not at all appropriate.

Scuttle Butt.—Boats carrying twenty men and upward should have a properly built scuttle butt, holding 40 or 50 gallons of water, placed on deck, fitted with a cover that would keep out the spray. This gives an ample supply on deck where it can get moderately cool and aerated.

Water Tanks.—The difficulties of obtaining a supply of good drinking water are very great. With station boats under 100 tons the question is not so difficult; the tanks are usually accessible for cleaning and, as the entire supply of water is taken from a shore station, a boat starting out from a station with her tanks fitted and perfectly clean, will have good water till her return, provided the covers have been snugly set up. But as soon as we pass to the class of boats that are sea-keeping, being fitted with a distiller of some description, the question of water becomes a trying one. Only the question of water tanks will be taken up here, as the distiller comes under steam engineering. Tanks are made of copper, tinned inside, or of galvanized iron, lined with cement. If these tanks are all accessible when in place, they can be emptied and kept well cleaned when in port. But on account of the desirability of carrying as large a supply of fresh water as possible, some of these tanks are so placed that the living quar-

ters must be abandoned, and a week consumed in getting them into an accessible position. The result is that those tanks soon get a deposit of iron rust and dirt that is but little noticed till the boat gets underway, when the water at once takes on a rich brown, and remains that way till the boat is again tied up to the dock. Then the slightest leak in a man-hole or hand-hole resulting from replacing the plate after last cleaning, and the sea from the bilge, or spray through the hatch salts up a tank. If to this is added the occasional salting that is given from the evaporator or distiller it is easily seen that fresh water is a dear article on board. A tank that is not accessible for cleaning by the force on board is of no use for fresh water for drinking or for the boiler.

Steering Engine.—The steering engine installed in the Porter class of boats is excellent, and gives perfect control, combined with lightness, durability, and handiness. The shifting from steam to hand is done with facility, and the radiation from the engine is not great. On one of the boats of the Winslow type an engine has been fitted that would probably be sufficiently powerful to control the Yorktown, while the heat caused the helmsman to faint away. Few men could take a trick at the wheel in rough weather without becoming seasick.

On the McKenzie class is fitted what is wittily termed the "Armstrong" system, being a tremendously heavy hand-wheel with cogged gearing which is slow and cumbersome in its action, and probably weighing more than a steam steerer fitted on the Talbot.

Criticisms on Ordnance.

In general terms our torpedo-boats are over-armed with torpedoes and under-armed with guns.

In the boats represented by the Talbot, the armament is two central pivot tubes and one 1-pdr. This is about all that the boat can carry. The 1-pdr. should be mounted on the forward tower instead of the after one, and a 6-mm. machine gun near the boat davits.

In class Q (100-150-ton station boats) the Cushing has three short tubes and three 1-pdrs., the Ericsson the same, the Morris two long torpedoes and four 1-pdrs., the Winslow class, three short tubes, four torpedoes, and three 1-pdrs. In all of these

boats two long torpedoes and three 6-pdrs. would give much greater efficiency.

In the sea-keeping torpedo-boats, class P (over 150 tons), two long torpedoes, three 6-pdrs. In the destroyer class two long torpedoes, one 12-pdr., five 6-pdrs. would be a suitable battery.

In the arrangement of battery the most desirable result would seem to be to always place the most powerful gun on the forecastle, the others equally but unsymmetrically along the sides of the boat, especially arranged for bow-fire. The gun mount should not sponson or project over the side; but a hinged grating should be fitted so that when swung out the gun captain would have a platform for all-round fire that would only be limited by the smokestacks, conning tower, and the other guns. It is believed that the following tactical considerations will justify this selection and arrangement of battery.

When the torpedo-boat is fulfilling its proper function, and is making a night attack upon a battleship or an armored cruiser, the battery would not be manned at all. After the torpedo was adjusted and set to probable angle of fire two men only would be stationed at each tube, one to fire and the other to change the train if desired; or to fire in case the first man was disabled. All other men would be below deck except the officer and the man at the wheel. After firing the torpedoes the boat would rely entirely upon her engines to escape. The flash of the guns from the torpedo-boat would only form a target for the rain of projectiles from the ship; good tactics would demand that they be abandoned and save the exposure of the crews.

The next case to be considered is that of a torpedo-boat pursuing another torpedo-boat, merchant steamer, or other vessel. In this case it is desirable that the battery be placed especially for bow-fire, if possible all guns firing directly ahead, so that they can be brought to bear in chase.

In the third case of a battle between the boat and another boat or vessel of equal or superior size and power. If the vessel is about an equal match a head-on attack with the three guns firing would be made, until within a telling range, say 800 or 1000 yards, when with a sheer of the helm 15 or 20 degrees the whole battery could be brought to bear and with their greatest efficiency, while the target was greatest, *e. g.*, until the boat passed to a quarter bearing when an attempt to return under the enemy's

quarter would be made. This might end in steering in a circle; if so the battery could still be employed with full effect. In case the enemy were a superior—a destroyer or a gunboat—the first effort would be to escape, the two after guns being employed in an attempt to disable him. Should it appear that escape was improbable, by turning about and charging at his bows and using these three forward guns the effect of the charge might be very demoralizing, as of course the discharge of a torpedo would be anticipated. Just when the torpedo would be discharged would depend upon the manœuvres of the enemy.

Attack upon a Superior.—It is not unlikely that the enemy would attempt to turn at 1000 yards and possibly attempt to increase the distance to avoid the torpedo. This then would probably offer a chance to fire both the torpedoes at 600 yards or less, at the broadside of the enemy, then sheering off his quarter. This should insure the destruction of the enemy, and possibly also that of the torpedo-boat; but the torpedo-boat would stand the better chance of living through the engagement, and assuming that they both went down, the crew of the smaller boat has the better chance of surviving, as crews can get overboard with the small boats, gratings, etc., immediately, and the suction from the sinking boat would be less. A good many men made their escape from the Furor when she went down off Santiago; this was probably an average case.

These rather hazardous tactics are believed to be superior to the slow and certain destruction brought on by the cool and deliberate shots of a superior pursuer, who, free from excitement, with little risk of accident, sinks or blows up the boat at his leisure with his forward battery. For any torpedo-boat or destroyer to deliberately come out and attack a superior vessel in broad daylight is mere bravado, and has proved a failure in many cases.

A recent example of such failures was the attack on the St. Paul by the Spanish destroyer Terror. The boat was promptly disabled, and again turned toward the port.

Of course every precaution should be taken to prevent these small craft from being placed in such perilous positions; but as shown in the manœuvres abroad, it is not unusual for daylight to catch them far from their home station, the prey of a passing scout. The first effort would be to escape into the nearest shoal, or port; but failing in this a final attack would seem better than slow destruction in a vain effort to escape.

In the tactics employed a strong point to be considered is that a man will fight better and shoot straighter, under the stimulus and excitement of a charge than when fleeing from a superior enemy. He has the encouragement of the offensive rôle, with the advantage of a surprise, and yet the employment of his full battery. If his pursuer be a gun-boat the latter probably could employ only a very small part of his battery until he could turn his broadside; he might even reach torpedo range before the gun-boat captain realized the importance of this, and turn only in time to afford a broad target for the torpedo.

In the case where sea-going torpedo-boats are scouting for the fleet, especially in night formations where they represent the feelers, their duty is to let no torpedo-vessel pass through their lines toward the battleships. The instructions in the Spanish war, when it was expected that the Spanish destroyers might be met, were that they must be stopped at all hazards by any boat or boats discovering them. This of course meant a charge with all guns bearing that were possible. Three 6-pdrs. well manned in a charge might stand a good show in such a fight against the present battery of the destroyers as arranged abroad.

The shifting of the 1-pdr. in 100-foot boats from aft to forward tower no one will dispute.

The selection of three 6-pdrs. is based on the following reasons:

(1) These boats being destined for sea trips of moderate length risk encounters with other large torpedo-boat destroyers and small gun-boats.

With this battery, the chances of disabling their opponents in any of these classes might be good; with the present 1-pdrs. they would be small indeed. The effect of a 6-pdr. at 2500 yards or under would probably suffice to wreck steering-gear and machinery quite as effectually as the 12-pdr., while the probability of a hit from any gun at a greater range than 3000 yards from the lively platform afforded by these boats is small. Briefly it is thought that the 6-pdr. covers the range of 1000-3000 yards as well as the larger gun; while the 1-pdr. counts for but little beyond 1000, so that it is badly outclassed by the 6-pdr.

In the matter of weight the 6-pdr. counts as about 4-1. So that in the Morris type the second and third 6-pdrs. would be gained at the sacrifice of the third torpedo. In the Porter type the same is true.

That any torpedo-boat should carry a spare torpedo seems to be without reason. She is not going to have time during an engagement to place this torpedo in the tube and fire it; and after the engagement is over, if the boat is still serviceable, she can return to her station for a new outfit of torpedoes, or else get them from the battleships of the fleet. Even the advantages claimed for three torpedoes over two seem scarcely to be sufficient. If the boat has on board two torpedoes, in good order ready for use, the careful delivery of these two shots at a reasonably close range ought certainly to result in the destruction of the ship at which the shot is directed. If there are three or more torpedoes to be fired it is feared that the feeling that one of them surely ought to hit because of the number of them, if only they can all be fired, would lead to less careful firing; while a desire to get in the whole number in the brief interval of the engagement would tempt the use of the first one at an uncertain or impossible range. It is the feeling of the writer that the opportunity which offered a chance for two shots properly and deliberately executed, two torpedoes would serve as well as ten.

The transfer of torpedoes from the battleships even in moderately rough weather could be accomplished by sending over the head, flask, and afterbody separately boxed if necessary.

The Air Compressor.—The types that depend upon leather washers for their proper working have been found most unsatisfactory. On the two largest boats tolerable success was attained; but the other boats kept their torpedoes charged with great difficulty. An entire day and night would sometimes be consumed in an attempt to charge a single torpedo. The failures being due to burnt out and leaky washers. All of the boats of an older date than the Talbot need new compressors. The type on the Talbot and McKenzie has proved satisfactory. The machine is able to charge the torpedo in a reasonable time, even if one cylinder be disabled from any cause. This has been done in cases where it was thought important to charge the torpedo at once.

While the torpedo director is a simple and accurate instrument, the conditions demanding its employment on board a torpedo-boat do not seem likely to arise, and it seems to be an unnecessary fitting. With the Obry gear the speed of the torpedo-boat is no longer a consideration. In attempting to reckon on the speed

of the enemy, an allowance, such as half a ship's length or a ship's length as the case may be, would be as accurate as could be expected. An attempt to use the instrument at night on a torpedo-boat would be absurd.

Criticism of Certain Points in Equipment.

The allowance and outfit from this Bureau is so small that there are few points for discussion. The only important items are the compass, the electric plant, and the anchor gear.

The wire anchor cables on the Winslow class seem to have been too light, one boat having parted three cables while at anchor at Key West. The cables had been kept well covered with vaseline, and showed no sign of deterioration. The anchor for this type also seemed too light. The boats dragged often and one anchor parted at the middle of the arm. One of these boats, anchored in five fathoms of water used a 3½-inch Manila hawser, slipping and buoying when getting under way, and rode out a fresh norther with this tackle. These hawsers are much used by schooners, and when care is used to prevent chafing are of great service under special conditions. The ground tackle of the Talbot class seems to have worked well, and the method of hoisting the anchor by means of the steering engine is very neat, and works well, saving a second engine. In the Porter class the anchor-gear seemed to work well, but the high bow, and light draft forward makes these boats very uneasy at their anchors, requiring the second anchor for the slightest squall.

The standard compass in the different boats seems to have been well placed and given good service. The Negus compass on the Gwin class is satisfactory for the rough work required.

The dynamos and the electric installation have given good service. They are needed on all boats except class R, which, however, need to be wired so that they can connect to the plant in the navy yard, when at the dock. A small search-light has been fitted at the forward conning tower of a good many boats. While it is useful for navigation, its usefulness for war service is doubtful, and the objections rather outweigh its advantages, its weight and conspicuous position are especially objectionable. Nor is the use of this light on the destroyer to be recommended. An effort to hold it upon the fleeing torpedo-boat would be unsuccessful from such an unsteady platform, and the attempt to pick

up a boat with it often leads to more confusion than success. This was found to be the case upon the blockade.

Criticism of Steam Engineering.

All of the boilers so far employed in our torpedo craft have been of the bent tube pattern, nearly all of them differing from the Thornycroft principally in the fact that they have drowned tubes. The advantages of the two systems are so well known that it is needless to enter into the discussion here. Criticism will be confined to especial points brought out by experience in working them.

Winslow Type.—In general terms this boiler, instead of a single upper drum amidships, has two upper drums each over its lower drum. As originally designed, there was a pipe connecting the upper drums, with the result that at sea, with the boat rolling, one gauge-glass would show full and the other empty. To overcome this objection the connection between the upper drums was abolished, resulting in making the two halves independent, or in other words giving two small boilers instead of one large one. To supply them with feed water the feed pipe forked in the fire-room, feeding each side through a check in the upper drum. It was found almost impossible to feed the two sides equally through this forked pipe. The result was that the water was always tended badly; generally it was carried too high, with the resultant water in the cylinder, but occasionally it was lost entirely and on one or more occasions burnt tubes to show for it. It was not that the men were green or nervous; many men were tried in this billet on the different boats, old and experienced water-tenders were equally unsuccessful. Even if the water by careful watching can be successfully controlled it doubles the force required in the fire-room, for when using the ordinary type of boiler one experienced man tends water, gets out coal, and fires in the ordinary work of running around a station, when running at low speeds for cruising. If the boat is to make about her maximum speed the second man is needed to get out coal and to take a turn at the firing, but the water gives no trouble. Then the lower drums of this boiler were so small that only a boy could get into them, and the rolling of a tube by the force on board was impossible; moreover the efficiency of the boy's work was

always doubtful. This boiler had a blank flange on the side of the pipe leading to the safety valve; the metal used to blank off the orifice was too light and springing slightly at the high pressures blew out the gasket and cleared the fire-room on several occasions. It is often the case that when the man is driven out of the fire-room by the bursting of a pipe or a bad joint that he will be able to throw open the furnace doors but not haul the fires. If there is a small port between the fire- and engine-room a hose can be played through this port from the donkey engine and thus wet down the fire till it can be controlled. The great importance of having safety valves and boiler and engine stops accessible from the deck is generally recognized, and most of our boats are so fitted. The deck valves should always be used after the run to shut off the steam, and frequently to insure their easy working.

Distribution and Service in Time of Peace.

This should correspond as far as possible with that which the boat would see in time of war. Consequently the station boats of the Talbot class should be distributed in the neighborhood of their cruising-ground in order to thoroughly familiarize themselves with the channels and coast in all conditions of weather and in all seasons. If possible, their crews should come from that district, and they should be allowed to remain there the greater part of the year. During a certain season they should be withdrawn to a more favorable climate for torpedo practice, manœuvres with the fleet, or such employment as might be demanded by the exigencies of the service. The assembly of them all at Newport in the summer would give a fine opportunity for concerted action with the fleet. Boats belonging to the district north of Philadelphia would do well to winter not further north than the Chesapeake Bay.

The larger boats designed to act with the squadron should conform in a general way with the movements of the large ships; that is, to visit our southern ports in the winter, and then assemble on the New England coast for combined practice in the summer.

The recommendations of the different commanding officers at the end of the war no doubt gave a very good idea of the needs

of the boats as regards the complements of the crews. In general terms it was more men and higher ratings. It is difficult to see how larger crews can be accommodated in the crew space allowed. The only remedy is to avoid keeping crews on arduous duty such long periods at a stretch. Then, too, it must be remembered that most of these boats in the war did service calling for work beyond the scope of the boat and the crews as well. For work extending only over a short period their crews were sufficient. In regard to the rating, it is of course impossible to have each man a chief machinist or a chief gunner's mate; but the rate on deck should not be less than a seaman, and that in the engineer's force not lower than fireman, first class. In considering the fitness of a man for a torpedo-boat, it is important to consider his liability to seasickness. Very good men on larger ships sometimes prove to be of little value when the boat gets caught in a gale—a time when a man can be illy spared from his work. Men detailed for this service must be moderately young, of good habits, not liable to severe seasickness, intelligent and reliable. Any severe punishment inflicted is sure to react on the rest of the crew as well, since it brings extra duty on all of them. The opportunities for obtaining liquor are greatly increased as compared with the condition on board a large ship. The regulations now require that a man who has served on a torpedo-boat be marked as to his special fitness for that duty. By this means a corps of men specially fitted for this work can be obtained by the department, so that when it is desired to bring the crew of a boat up to its full complement, the seamen can be drafted from other duty to these vessels.

Officers.—During the war the detail of officers for torpedo-boats was one officer for class R (the Gwin type) and two officers for classes Q and P, there being no class O, or destroyers. This made the duty quite severe at times, but as there was a lack of officers, and none but regulars were desired on this duty, they preferred this arrangement.

The following temporary increase for the time the boat was in active service, either in time of peace or war, would be much better. On boats of class R, two officers; on both class Q and class P, three officers; on the destroyers, four officers. One of these officers should always be detailed for the engine-room, taking duty on deck, or excused from that, according as the com-

manding officer saw fit. In boats having more than two officers on board, this detail should be shifted after a time, say three months.

Experience on these boats, both on deck and in the engine-room, is most valuable for young officers, and when the boats are called out for active service in manœuvres, etc., the supply of young officers in the junior officers' quarters of the large ships should be drawn on to fill the complement of the boats. The experience in harbor pilotage, navigation, knowledge of harbors, etc., comes to them at an age when they are quick to learn, and responsibility sits lightly upon them.

Boats in reserve.—The question has arisen, What are we to do with our boats during the time that they are not needed on active service? Two propositions are to be considered and have been tried to a certain extent. One is to haul the boats up on a set of ways that is roofed over, and leave them there till they are needed for active work. A complete design for a large boat-house fitted with railway by which a boat can be hauled out, and a turn-table so that it can be switched to a side-track and another boat be hauled in, has been considered. Following out this idea, four boats were hauled out last year at the New York yard. The other proposition is to reduce the crews to the minimum needed to care for the boat, and moor the boat in a regular stall or pen so that no especial watch is needed to secure her safety. An officer is then placed in command of two or more of these boats, and inspects them regularly, testing the machinery at regular intervals and taking out the boat for a run at certain intervals to insure her readiness for service at all times. When boats are kept in this manner they are actually ready for service; and by drafting the additional number of men needed for the class of service demanded of the boat, she would be ready to leave in twelve hours, or even less time. The most important men are thoroughly familiar with their duties, and can quickly instruct the others. This has been tried on some of the boats and seemed to work satisfactorily.

If the boat be on the ways, and it is desired to use her, she is put in the water, and officers and crew are ordered to her; orders are given for a dock trial, and then follows a long itemized requisition for repairs needed before the boat is ready for service; steam joints are not tight and need re-packing, the con-

denser leaks, or the feed pump needs overhauling, or the water-tanks must be cleaned out, etc., etc., and the boat does not get away from the navy yard for weeks. There is no one to blame. Time and disuse will always bring about some such condition, and then if on top of this there has been any neglect in the precautions to preserve the boat when she was laid up, the trouble is increased many fold. A court of inquiry may follow, and after a long search may, or may not, find where the fault was; but this will not help the boat. She is finally hustled away from the navy yard, though her men have not yet learned all their duties. If she escapes the discomfiture of an early return she will be fortunate. The new officers blame the navy yard work, and the navy yard either blames the people from whom she was received, or says that they do not know how to run her.

The two arguments in favor of hauling her out were: (1) that it was more economical and (2) that the men were needed elsewhere.

In regard to the economy, if the bill for repairs be examined after the boat has left the navy yard it will no doubt about equal the cost of maintenance of a reserve crew on board. Moreover, if there had been a need for this boat she could have been used at once if kept in reserve, and can be counted on as actual offensive power available.

In regard to the need of the men elsewhere, a detail of from six to ten men will be sufficient for each boat, so that the laying up of one big cruiser would suffice to maintain fifty torpedo-boats. It is admitted that the rates of these men would run a little higher than the total of a crew of a large ship.

From the experience that has been obtained with our boats, it is thought that the following detail would suffice for all boats:

A chief machinist and a machinist first-class for the engine-room, an oiler for each engine, one water-tender for the fire-room; if there is more than one boiler, an extra man in the fire-room for each additional boiler. In the deck force would be needed a chief gunner's mate, a quartermaster first-class, and for class P a seaman.

When these boats are in reserve they should be arranged in groups of three or four, placing as far as possible sister boats in the same group. A lieutenant to be placed in charge of each group. His duties would be to keep the group in running order

and to take out each boat at least once a month for exercise. Target practice at full speed with torpedoes, and with the battery, to be held as often as circumstances would permit. The Navy Department requires that the former be held at least once a month, and the latter at least once a quarter. In fine weather these exercises could be held very much oftener. The boat selected to go out for practice should carry an additional crew taken from one of the other boats, thereby giving them double the practice, and lightening their duties. It is thought that the best results are undoubtedly obtained by keeping the boats in commission and requiring the men to live on board them. A man never takes the same interest in a ship or boat unless he lives in her, nor does he form a proper sea-habit. If he live in barracks on shore, the sharp contrast of his first night at sea, or his weeks at some other port than a navy yard, makes him dissatisfied and inefficient. The boats are comfortable enough when at the dock; and when at sea the man can sleep better in his accustomed bunk, in fact is at home on board, which the barrack's man is not.

Drills.—The minimum number of drills and exercises each quarter having been established, it is all important that there be an annual mobilization of this fleet at one of our important bases for a complete and thorough series of exercises in co-operation with the fleet. Newport offers the best rendezvous for battleships, cruisers and torpedo craft; while its deep water and moderate tides and land-locked coves offer fine opportunity for practice. Night attacks should be made upon the fleet while at sea protected by destroyers, and upon single vessels in the harbor; tests as to relative visibility of different types of torpedo-boats would show the value of the station boat; urgently needed training of the firemen to prevent the sudden flare from the smokestack when the near approach has begun; careful training to enable the boat to get within torpedo range with full pressure of steam, and yet not lift the safety valve. Thus a more perfect knowledge of the value of the torpedo-boat will be obtained by the officers on the battleships. The naval officer possesses the happy faculty of forgetting his anxieties and hardships; so that already the strain of the first few nights on the Santiago blockade are but faint memories. The statement is too often heard from officers that have known better, that "torpedo-boats don't

amount to much; they did nothing during the war. We tested their attacks at Key West."

What different work would the blockade have been had we lost a battleship during the early days of the blockade by a night sortie from Santiago. There were a large number of phantom torpedo-boats chased and sunk as it was, but the memory of the sudden destruction of a battleship would have made them legion.

The writer does not believe that the torpedo-boat can perform miracles (especially without considerable exercise and practice beforehand), but these boats have an important rôle in naval warfare, in which they have been, and will be, employed with telling, and at times, demoralizing effect.

In conclusion, we need three types of torpedo vessels to meet the conditions which will arise in case of war, and we need trained crews to render them efficient in time of need. The former rests in part with our national legislators; but the latter can most efficiently be maintained by keeping a nucleus on each boat, and thus keeping each boat ever ready for service.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE AUTOMOBILE TORPEDO AND ITS USES.

A DISCUSSION OF THE TORPEDO POLICY BEST ADAPTED FOR THE UNITED STATES NAVAL SERVICE.

By Lieutenant L. H. Chandler, U. S. Navy.

Motto:—"In a word, the torpedo has brought into the Navy a fresh zest, a new romance, and possibilities more brilliant than were ever existent before its adoption."—*Torpedoes and Torpedo Vessels, Lieut. G. E. Armstrong, R. N.*

1. In opening this paper, the writer may as well admit at once that he is an enthusiast on the subject of torpedoes, but he hopes that he is a moderate one and that he fully realizes the limitations of the weapon. He has always been a friend of the so-called "freaks" of the navy, being of the opinion that each of these is of great value under certain conditions and of almost none under all others. What is considered to be the proper field of the torpedo will be pretty thoroughly demonstrated as this paper progresses.

2. The endeavor will be made to show under what circumstances and by what means torpedo warfare can be best carried on by our service with a good fighting show of success. It has seemed to the writer that there is too little literature extant on this subject from the thinkers of the navy, and this paper is prepared in the hope that it may bring forth arguments from those having knowledge and experience in torpedo matters, so that the interest of the service may be excited and a better appreciation of the subject gained by all. Doubtless in the course of the article many old ideas, not original with the writer, have had to be dressed up and dragged to the front again, but the subject in hand has received so little discussion of late in our

service and the advance made in torpedo material has been so great that there is an evident need for a further stirring up of minds in regard thereto, and this fact must be accepted as an apology for the reproduction here of many ideas that have been often presented before.

3. Throughout this paper the object has been to consider the matter temperately and to discuss only those methods which promise rather more than a mere possibility of success. While arguing from this standpoint alone it is not meant that unusual exertions under special circumstances may not accomplish results with conditions far more unfavorable than those in any of the situations here considered. It is thought that they would, but the effort has been to avoid making claims for possibilities of success except where there are very good grounds for believing such success to be more than likely. When a new weapon is introduced it is frequently killed by the exorbitant claims of its friends. It may be put down as an axiom that the difficulty of using a weapon successfully increases directly (and perhaps in a higher degree) with the deadliness of its effect. Such being the case, the frequent claims that some particular mechanism for handling high explosives in warfare is going to revolutionize present methods inevitably redounds, as do all excesses, to the detriment of the device in question. The writer has here tried to avoid this mistake.

4. Torpedo-boats and torpedoes are essentially a part of the harbor-defense system of this country. Unlike the powers of Europe, our coast is too far from an enemy's shores, with a possible exception, to make the passage of torpedo vessels from one to the other for hostile purposes a very likely occurrence. It is asked that this statement in regard to the proper sphere of action of torpedo vessels may be accepted for the present as true, for the sake of argument, and the reasons for this belief will be developed at length as the paper progresses. In relation to it, it may be said that the oft-made comparison between the torpedo-boat and the highly-bred race horse is an apt one. Each is the highest type of its race, each gives the maximum speed attainable by any of its kind, each has to be carefully groomed and cared for at all times, but more especially just prior to trial; each will be quickly broken down by constant driving over rough ways, and conversely each will be quickly ruined by lack

of proper exercise, while each requires the most expert knowledge on the part of the handlers.

5. But why carry the comparison further? Does not every point advanced go to show that the sole legitimate duty of the torpedo-boat is to choose its own time and weather, and, in company with others of its own kind, to dash forth from its own home port to an attack upon hostile ships within easy striking distance, as would be those of a blockading force?

6. The consideration of the question of torpedo warfare will be taken up in this paper under the following heads:

A. The limitations of torpedo-boats and of their weapons.

B. The method of approach and of attack.

C. The stationing of the flotilla in time of war and in time of peace.

D. The care and preservation of the boats in war and in peace.

E. The proper training of the personnel.

F. Circumstances under which the flotilla may be of assistance to the fleet.

G. The question of ship's torpedo-boats.

H. Modifications of the preceding arguments to make them applicable to torpedo-boat destroyers.

I. The use of torpedoes on board vessels not specifically designed therefor.

J. The use of boats at a distance from their base. When possible and how best accomplished.

K. Modifications of the theoretically perfect system made necessary by our lack of boats, officers and men.

L. Types of boats and their standardization.

M. Types of torpedoes.

N. The bearing upon the above statements of the lessons of the war with Spain.

O. General summing up.

A. The Limitations of Torpedo-boats and of their Weapons.

7. As far as the boats themselves are concerned, the constant hard running incident to continuous cruising has always been found to disable machinery and render stale the personnel. On the contrary, boats can no more be laid up without a crew on

board and then be suddenly called into service and give effective results than can a watch be laid away motionless in a drawer for a long period and then be expected to run accurately when wound.

8. The ideal condition of boats for service is to keep them always in full commission, with full complements of officers and men on board, employed constantly near their base in short runs and torpedo practice. This keeps boats in condition, crew fresh and well instructed and weapons in good shape.

9. The introduction of the gyroscopic steering gear for torpedoes has done much to improve the accuracy of the weapon, but it has one great disadvantage. If not in perfect adjustment, this gear is worse than nothing, as it renders a miss certain. No gyroscope can be adjusted or even examined to see whether it is in adjustment or not, except upon the most stable platform. It is doubtful if it could be done on board even the largest ship, except under exceptional circumstances. Vibration from auxiliary machinery would probably be sufficient to render the adjustment very difficult, if not impossible. So it would seem that the gyroscopic steering gear can only be satisfactorily used when it can be taken ashore and adjusted or frequently examined for adjustment.

10. Torpedoes kept in tubes and ready for use on board torpedo-boats, as they must always be in war time, are subject to constant deluging with salt water when at sea, and it would seem that the chances of a successful run from a boat which had been long away from port would be very greatly reduced on that account.

11. For these reasons torpedo-boats cannot, except under exceptional circumstances, be called upon to operate far from their base.

B. The Method of Approach and of Attack.

12. This being one of the most important questions in relation to torpedo warfare, seems nevertheless to be one of the least discussed, at least in our service, and one in regard to which fewer fixed ideas and opinions prevail than almost any other. The German method seems to have many advantages. In this a "section boat" leads a "section" of six other boats in a wedge formation, the section boat at the apex, the two boats, one on each

quarter, forming the first "division," the two at the rear end of the right flank the second "division," and the two at the rear end of the left flank forming the third "division." These boats advance to the attack so close together, the section boat leading, that a man may step from the bow of one boat to the quarter of the one next ahead. Each follows the motions of the boat ahead, changes of speed being signalled by flashing a small lantern at the stern of each boat, so arranged that the light is thrown down into the wake. The wash from the screws tends to keep the boats from touching the sterns of their leaders. When sighted by the enemy, or at signal from the section boat, the boats spread out on each side and deliver the attack from seven different points of the compass, the section boat making a direct attack. Prior to the attack, a route of retreat is agreed upon to diminish the chances of collision.

13. The writer may say at once that he sees no better method of attack than this, then proceeding to criticise and discuss its leading features. Any scheme which involves preconcerted attack at the same moment by a number of vessels is difficult, even in the day-time; and at night, especially under the circumstances of weather when a torpedo attack should be made, it is almost certain that some of the boats would be ahead of the others. What is the best method of reducing this error to a minimum?

14. The first thing is to adopt the method of approach which shall keep the boats together as long as possible without subjecting them to the fire of the adversary while grouped or sacrificing the advantages of a scattered attack, while at the same time, the time element is eliminated to the greatest possible extent. The formation should be such as to permit the quickest possible systematic opening of order should the flotilla be discovered while grouped. The formation should be that which will enable the senior officer to retain control of all its units to the last moment possible while engaged in that hunt for his adversary which it will often be so difficult to bring to a successful termination.

15. It seems to the writer that the German wedge offers the best answer to all the above requirements. In it the senior officer retains control to the last moment possible, open order position is taken by the simultaneous action of all the boats, and

they can therefore more quickly spread, if detected while grouped, than from almost any other formation.

16. The ideal attack would, of course, be that in which the attacking force discovers its object without itself being at once detected. The approach being made at a speed sufficiently low to prevent the rolling up of a mass of foam under the bows and to enable the fires to be so handled that there will be no masses of flame bursting from the funnels, the section boat would continue towards the enemy at the same speed, changing her course if necessary; the signal for dispersion would be given, and the boats would spread out into positions say two points apart, at varying speeds, the flank boats moving most quickly. They would then continue the approach, the section boat gradually working up her speed, after allowing a time interval of short duration to elapse to give the others a chance to place themselves, and when discovered it would be full speed at once for all.

17. Of course if the section is discovered before it has opened out, full speed must be attained at once, and the wing boats would only spread out enough to break up the grouped target. In this connection a suggestion recently made by Lieutenant A. P. Niblack, U. S. Navy, might be adopted with probable success, it being for the boats as they spread to drop overboard phosphorescent buoys to tempt the fire of the enemy. A few such marks judiciously dropped in the open sectors as the boats cross them would probably prove a very strong temptation to the captains of the secondary guns.

18. In relation to the method of delivering the fire, it may be said that the introduction of the adjustable gyroscopic steering gear has added greatly to the chance of a hit. With, for example, two central pivot tubes on the fore and aft central line of the boat, these should be set one broad on each bow. The steering gears of the torpedoes should be set to bring them both to run parallel to the course of the boat at the moment of firing. Then the commanding officer has only to steer his boat for the point at which he wishes his torpedoes to run and to fire them at the right moment. Two torpedoes will thus be simultaneously discharged in directions ninety degrees apart, one of which will make a turn of forty-five degrees to the right and the other of the same amount to the left, and they will then run parallel at quite a distance apart. The advantage of such a method of fire over

anything possible prior to the latest improvement of the gyroscope is very apparent.

19. The return from the attack is not important. The boats should be saved if possible, of course; but no one can go out expecting to return, and any man who lets that idea seriously enter into his calculations had better stay at home altogether. Let it be agreed as to how the boats will turn for the retreat after delivering their fire, in order that the chances of running into each other may be diminished, and then let the boats all make the best of their way to a rendezvous independently. This spot should be as near the enemy as possible, while protected from him, and the boats should stand by there to help the injured until all are either in or given up.

20. The question of attack by two or more sections renders the matter still more complicated. The sections should remain together as long as possible without sacrificing any other advantages, and then the time element must be taken into account to secure simultaneous attack. The difficulties are manifest, and they can only be overcome by officers whose boats are a part of themselves and whose knowledge of each other and of the waters in which they are operating is so perfect as to be instinctive.

21. A question of importance to be considered is the avoidance of the enemy's picket boats, and here we have something which must be left more largely to the dictation of circumstances than almost any other part of the tactics. Whenever possible, the attack should be made from the quarter where it would be least expected, from the seaward if possible. Unfrequented and little known channels should be used to attain a position on the outer side of a blockading fleet, thus enabling the attack to be delivered from the off-shore side. Where practicable, the cutting of such channels at proper points should be made a part of the defenses of every harbor. At times it would, perhaps, be possible to have the attack delivered by a section from some other port than the one off which the enemy is lying, or by two sections, one from within and another from without simultaneously. An attack from off shore, assisted by a feint from the harbor mouth to distract the pickets and the enemy's fire (to be turned into a real attack if the chance occurs) would give great chances of success.

22. Failing in the chance to attack from an unexpected quarter, it would probably be best to make a few preliminary attacks to

destroy the picket vessels by gunfire, every such feint to be turned into a real attack if the chance comes. An effort might be made from within in weather in which the enemy would find it impossible to handle his small picket vessels.

23. Another method of attack proposed is to have the section find the quarry and then steam around it in column, boats dropping off the rear end at intervals, until all are distributed, when the attack is to be made. Here the section escorts each boat to its station and the time consumed in doing so would be relatively very great and the chances of discovery much increased. It would be impossible of accomplishment were the boats discovered as soon as they found the enemy, and the section would then be left without a plan.

24. Of course, the German wedge might be changed into a column, if desired, but the arguments for so doing are not clear. It does not seem likely that the boats in the wedge could be kept as close together as has been indicated, when operating under service conditions, and the danger to the bows of the boats from the twin screws of their leaders would be very great. The Germans make great use of single-screw boats, and it would be easier with them. It is also probable that the stern lights would have to be extinguished at least as soon as the proximity of an enemy was discovered.

25. The nomenclature here adopted differs somewhat from the German, and it may be well to give the following definitions of terms which are consistently used in this report:

(a) The "flotilla" includes all the torpedo vessels of the navy.

(b) A flotilla "section" is a squadron of seven boats acting together as a unit.

(c) A coast "district" is a section of the coast to which one or more sections are assigned.

(d) A district "base" is the depot and refitting establishment of the district.

C. The Stationing of the Flotilla in Time of War and in Time of Peace.

26. In discussing this question, the war basis will be first taken up, after which will be considered the changes that it seems most advisable to make in that disposition consequent upon the arrival of peace.

27. From his personal knowledge of torpedo-boat duty, the writer is very positively of the opinion that it is too complex and its wants too immediate to enable it to be properly handled under the present system, where the boats are, for various purposes, under the control of several independent bureaus. In the way of stores, the very smallness of their wants makes them subject to being overlooked in the bureaus, and such a failure will very largely ruin the efficiency of a boat. The flotilla should have some officer in the department, preferably in the office of the Assistant Secretary, who can take entire charge of the boats. He should be a man who has had large practical experience with torpedoes and torpedo-boats, and who is interested in his work and zealous for the advancement of the particular weapon with which he is concerned. All correspondence, requisitions, etc., relating to the flotilla should come to him, and he can then exercise the personal supervision over them which is now felt to be nobody's business. In other words, the flotilla must have a head. It is not desired that this head shall be so placed as to be antagonistic to the different bureaus; on the contrary, there should be chosen for the place an officer who will have tact enough to enable him to make himself regarded by each of the chiefs of the various bureaus in the light of an assistant in his own particular bureau, one who will take up the very small, but very important, details of the flotilla.

28. So much for the departmental organization of the flotilla. As far as the division of the torpedo force is concerned, the coast should be divided into districts, and the following is suggested as a most appropriate division:

No. of District.	Name of District.	Limits of District.	Base.
1.	Maine.	Eastport to Portland.	Rockland.
2.	New Hampshire.	Portland to Rockport.	Portsmouth.
3.	Massachusetts.	Gloucester to Provincetown.	Boston.
4.	Rhode Island.	Provincetown to Fisher's Id.	Newport.
5.	Long Island Sd.	Fisher's Island to New Haven.	New London.
6.	New York.	New Haven to Barnegat.	New York.
7.	Delaware.	Barnegat to Winter Quarter Shoal.	Near mouth of Delaware Bay.
8.	North Chesapeake.	Winter Quarter Shoal to Cape Henry and Chesapeake Bay, north of Thimble Shoal.	Yorktown.

No. of District.	Name of District.	Limits of District.	Base.
9. ...	South Chesapeake.	Cape Charles (Hampton Roads) to Cape Hatteras.	Fort Monroe.
10.	North Carolina.	Cape Hatteras to Cape Romain.	Wilmington.
11.	South Carolina.	Cape Romain to Port Royal.	Charleston.
12.	Georgia.	Port Royal to St. Mary's Entrance.	Savannah.
13.	Florida.	St. Mary's Entrance to Cape Canaveral.	Jacksonville.
14.	Key West.	Fowey Rocks to Dry Tortugas.	Key West.
15.	Tampa.	Key West to Apalachicola.	Tampa.
16.	Pensacola.	Cape San Blas to Ship Island.	Pensacola.
17.	Mississippi.	Ship Island to Atchafalaya Bay.	Near mouth of Mississippi R
18.	Galveston.	Atchafalaya Bay to Rio Grande.	Galveston.
19.	Porto Rico.	Porto Rico.	San Juan.
20.	Cuba.	Cuba.	Havana.
21.	Puget Sound.	Cape Scott (Vancouver Id.) to Westport (Washington).	Bremerton.
22.	Oregon.	Westport to Cape Blanco.	Astoria.
23.	North California.	Cape Blanco to San Francisco.	San Francisco.
24.	South California.	San Francisco to Point Conception.	San Francisco.
25.	San Diego.	Point Conception to the Rio Tia Juana.	San Diego.

29. Should Cuba be annexed, it would be advisable to have a North Cuba district, base at Havana; and a South Cuba district, base at Santiago. In the future the carrying out of the system here indicated by the formation of districts in the Hawaiian and Philippine Islands would naturally follow, but for the present discussion the division above indicated is sufficient.

30. To each coast district should be assigned a section of the flotilla, consisting of at least seven boats, say one destroyer and six boats. For this there would be required 175 boats, which is not an excessive number towards which to build.

31. The commanding officer of the destroyer in each section should command the section, and only officers who have had practical experience in torpedo work and who are believers in the weapon should be selected for this duty.

32. The section commander should also command the district base. The purpose and nature of these bases are indicated in

another section, and here it may only be stated that they should never be located at navy yards. Their great object will be set aside unless the section commanders can absolutely control them. A very few watchmen and laborers would need to be employed at each base.

33. The daily occupation of the flotilla in time of war is evidently a question which does not need discussion except as to tactics, and that point will be found covered in another section. Let us now proceed to the discussion of the stationing of the sections of the flotilla in time of peace.

34. To avoid sickness from climatic influences, the boats should come north in summer and go south in winter. This could be easily done without breaking up the flotilla sections by ordering two or more of them to the same district of coast for the season, each section to act as a unit, but the senior section commander to control them all.

35. Then, for purposes of instruction of personnel and preservation of material, section commanders should be required to keep their sections busy in legitimate work. Other senior officers should not be permitted to interfere, except at such times as the department should order one or more sections to report to the commander-in-chief of the heavy fleet for exercises.

36. It is not thought necessary to go into further elaboration of the details of this scheme. Its many advantages are manifest. Among them may be mentioned the ease with which two or more sections can generally be brought together. It would also be possible in many cases for one or more flotilla sections to deliver an attack from seaward upon a hostile fleet operating in another coast district.

37. As to the plea, which will doubtless be advanced, that we will never have enough boats for this division, the writer would say that any scheme is better than no scheme. He believes that the one here laid down is a consistent outline of the best methods of using the torpedo for coast defense, which he believes to be its legitimate field, and does not think that the number of boats mentioned will be in excess of the number that our navy will finally have. As soon as the boats now building are finished, the many voters employed in their construction will be certain to bring their influence to bear upon Congress for the purpose of having the construction of more boats authorized.

D. The Care and Preservation of the Boats in War and Peace.

38. The arguments advanced in the preceding sections make it almost unnecessary for the writer to state that he is most strongly of the opinion that there is but one way, either in peace or war, in which the torpedo-boat flotilla can be kept ready for duty on short notice, and that way is to keep all the boats constantly in service. The least dangerous modification of this method will be considered later in this paper, but for the present the discussion will be confined to the ideal condition indicated, that where all the boats are in commission with full complements at all times.

39. At the base of each district there should be proper wharves and storehouses. Each boat should have its own wharf and its own storerooms, to which the commanding officer should have the key. Thus each boat could have her supplies at hand, and yet the present overcrowded condition of the boats in regard to stores could be avoided. There should be barracks for the men, who should ordinarily live there, and a separate dormitory for each boat, with either separate messes or a common mess for all, as circumstances might show to be best. A separate building, with sleeping apartments and accommodations and mess arrangements for all the officers of the section should be arranged. Then, as in almost all foreign torpedo services, the officers and men could live under sanitary conditions, making such daily runs as might be desired for exercise, and living on board the boats for short periods during more extended runs to the limits of the coast district.

40. At each base there should be a coal shed with the best quality of coal in bags, so arranged that it could be carted to the wharves alongside the boats ready for speedy coaling. Fresh water connections should be established alongside each boat. A general storehouse at each base should also be maintained, where standard stores of all kinds should be kept on hand, together with a supply of such special stores as might be needed for each particular boat. This storehouse should be able to meet at once every possible want of each individual boat without the necessity of waiting for the accomplishment of a purchase. Every system of accounts or requisitions which in

the slightest degree retards the supply of the boats should be changed at once. Torpedo-boat officers cannot keep books and handle returns and reports except to the extreme detriment of their legitimate work. A small machine-shop capable of doing torpedo repairs of moderate dimensions should be established at each base, where work could be done by the force of the boat needing it. It is thought that advantages would accrue by having the machinists who run the engines do as much as is possible of the repair work upon them. At each base there should be a dock or railway capable of taking from the water the largest destroyer, even were she in a sinking condition.

41. With the facilities herein recommended, commanding officers could with ease gain every sort of experience necessary, run their boats continuously to keep them in proper order without using them up, could oversee and direct such repairs as became necessary, and would have every facility for torpedo and gun practice.

E. The Proper Training of the Personnel.

42. We must bear in mind the delicacy of the mechanisms involved and the extreme difficulty of the service upon which the officers and men of the flotilla are to be sent. Each torpedo is an individual whose whims and fancies are only known to him who has watched and lived with that individual weapon for many days. Each boat is an individual, and a very highly strung one too, whose eccentricities of helm and general action must be learned by experience. Each engine is an individual whose peculiarities can be known only to those who have spent days and nights with it under all conditions. The cracking of some obscure and unnoticed valve, when the critical moment comes, may set at nought all efforts. The compasses all are individuals, many of which do not come far from being invalids (such uncompensated errors as 50 degrees are frequent), and only by the greatest familiarity with his own particular one can an officer hope to guide his boat aright through the darkness, rain or fog through which the attack should be delivered.

43. Imagine, then, an officer and crew sent aboard a strange boat to go out as soon as possible to the attack in the darkness and storm. The officer has no confidence in his compass, and

if that boat has just come from reserve, his lack of confidence would undoubtedly be justified. The engineer's force are in constant doubt as to what they are doing, which is not conducive to steadiness on the part of men moving among such machinery as is found in the engine and fire-rooms of a torpedo-boat. The deck force have no idea as to what the torpedoes will take it into their heads to do when fired.

44. Is it right to so place officers and men who are willing and eager to risk their lives in the most dangerous form of attack known to modern warfare? Is the general feeling of strangeness and doubt which must prevail under these circumstances the proper atmosphere in which to send men out to such duty?

45. The answer is plain. Only after long familiarity with every detail of the individual boat and her outfit, the equipment, and armament, can officers and men justly be called upon to set forth upon that journey from which no man who starts can ever reasonably expect to return.

46. Therefore, most emphatically, boats should be kept in commission with officers and men on board at all times, and upon the outbreak of hostilities the greatest caution should be exercised that changes in the personnel may be reduced to a minimum. Exercise runs should be of almost daily occurrence, and should be taken under all possible conditions of weather, etc., at night as well as in the day-time. This also should be done in sections as for attack, and separate sections should be exercised in delivering the attack at a certain point simultaneously, as it would have to be done in actual service.

47. The question of training of officers as local pilots in the waters in which they are to operate is of the utmost importance, and by the plan here proposed officers could gain that knowledge to the utmost, each for his own district; and then in case of concentration on any particular district, there would always be competent pilots to lead the formation.

48. The torpedo-boat sections should also be frequently exercised with the heavy fleet, being placed temporarily under the orders of the commander-in-chief for that purpose. These exercises should include night attacks upon the fleet under service conditions and also co-operation with the fleet against an enemy.

F. Circumstances under which the Flotilla may be of Assistance to the Fleet.

49. If a fleet leaves a blockaded port, or one threatened by the approach of an enemy, the torpedo flotilla could probably be of material assistance. Several boats could hang under the shelter of each large ship until the moment arrived for action. It is doubted, however, whether the boats would be able to get far in the day-time, even under such circumstances; they are too easily destroyed. Every argument would point to delivering an attack from a home port against a foreign enemy in pilotage waters at night, and then the boats would stand an excellent show of accomplishing something. In such a case, however, the plan of action must be clearly understood, and by the gun-pointers of the big ships as well as by their officers, for under the best of circumstances the torpedo-boats will be very apt to receive an occasional shot from their own ships.

50. Operations with the fleet at a distance from the base, it is believed, could only be successfully carried on under the conditions mentioned in section J, and the results of such operations are matters of grave doubt to the writer.

51. Any attempt to make the boats a part of the heavy squadron for general purposes will surely result in utter failure and the ruin at least temporarily of the boats. When called upon for the supreme test they will be found wanting, in all likelihood, and the blame will fall upon those officers and men who are risking their lives and reputations in this most hazardous calling instead of upon those in high places who order such action.

52. The flotilla could be of undoubted service in aiding the fleet to repulse an enemy who was endeavoring to force an entrance into a harbor. The tactics for this purpose would depend so much upon the topography and hydrography of the port that no general rules can be laid down, other than that the fullest advantage must be taken of all favorable points.

G. The Question of Ship's Torpedo-boats.

53. The tendency in our navy of late has been to do away with this form of launch, and this the writer believes to be a mistake. These boats can do what the regular flotilla cannot: they can go with the fleet under all circumstances, ready for use if the con-

ditions proved favorable. They can deliver a very fair attack under certain conditions, which would be not unlikely to occur, and they would be invaluable as picket launches, etc.

54. The boat adopted for this service should be as fast as may be without sacrificing her seaworthy qualities, should be as large as can be handily carried and gotten in and out, should have a single central pivot tube on the fore and aft line on deck, and should not be called upon to carry air compressors or other unnecessary machinery. The torpedo should be placed aboard her ready for firing.

55. It would be an undoubted advantage for every fleet to have with it a torpedo depot and repair ship such as the English Vulcan, which would be a supply and repair ship for all torpedo material, and could carry half a dozen torpedo boats of a higher type than the regular vessels of war could accommodate.

56. Very stringent regulations in regard to the use of ship's boats should be passed. They should be exercised with their crews at every possible opportunity, and at the same time their use, even occasional, as steam launches should be most strictly forbidden.

H. Modification of the Preceding Arguments to make them Applicable to Torpedo-boat Destroyers.

57. Fundamentally, the destroyer is built to cruise with and to act as an adjunct to the fleet, to repel torpedo-boat attacks, and to destroy the attacking boats. The writer finds it a little difficult to see how there is much chance for them to perform these legitimate duties in our navy. The type was called into being in Europe where the countries are so close together that a blockading fleet could easily take the destroyers with it, which would of course be an enormous advantage. The destroyers could there habitually cruise off the enemy's coast. On our part, with the possible exception of the English possessions to the north and of certain nations of no military importance to the south, our destroyers could never do this. The possibilities of getting them across the ocean in condition to work are practically nil. In the same way it seems very unlikely that they would ever be called upon to combat any boats of a higher type than those carried by big ships, for how are others to be brought to our coast?

58. Admitting that this argument is sound, our own destroyers will then be used more as torpedo-boats than for their theoretical purpose. They become with us simply torpedo-boats of a greater range of action, but that range is not great enough to take them far from their bases. Their tactics may then be considered as the same as those of the boats previously considered, only with the distance scale and that of ability to keep the sea in bad weather somewhat increased. The destroyers in a certain locality could be brought together to deliver an attack upon an enemy off the coast under circumstances of weather and distance which would bar the smaller boats from action, and such is believed to be their proper sphere of action in our navy.

I. The Use of Torpedoes on Board Vessels not specially designed therefor.

59. The writer believes that torpedoes in unprotected positions on board ship are a source of danger great enough to more than compensate for any possible advantage that might accrue from their presence. On board vessels built for the special purpose this risk is a legitimate one which is of a necessity to be run, but it should not be taken on board larger ships except under very exceptional circumstances.

60. If a vessel be large enough to carry a couple of submerged tubes, torpedoes then become weapons which may be invaluable; and they should certainly be installed, for their presence in no way constitutes more than ordinary danger. In this connection it may be remarked that with such tubes it will be essential that the actual firing be done, without any intermediary, from the pointing station on deck, and also that the captain of a ship in action cannot possibly give the matter sufficient attention to do it himself. An experienced torpedo officer should be stationed where he can himself fire the torpedo at the proper moment, as shown by his own judgment, after having been notified by the captain that an opportunity for the use of the weapon is expected. The retention of above-water tubes and torpedoes without war-heads on board regular war vessels for purposes of instruction and practice only, of course, does not affect the point at issue.

61. Under exceptional circumstances, where a weak vessel must face overwhelming odds, in defense of her own home ports

for instance, it is recognized that the torpedo is the only weapon which can place the weak vessel on an equality with the strong one. In this case it is submitted that the weak vessel loses her own character and becomes distinctly a torpedo vessel, and advantage should be taken of torpedo tactics pure and simple in delivering the attack. Tubes for this purpose could be placed aboard any vessel on very short notice, and it is thought that the chance of such a condition arising is not sufficiently great to warrant other action than the mere consideration of the circumstances as here set forth. On board the larger vessels, where the room can easily be spared, the retention of a couple of tubes for practice is the adopted policy, and war-heads might be supplied to such ships. If they are, however, it should be understood they are for these forlorn hope tactics, and no captain should be subjected to censure because of their presence should he prefer to go into an ordinary action with them stowed away below.

J. The Use of Boats at Distances from their Bases. When Possible and how best Accomplished.

62. It may sometimes happen that it is highly desirable to operate the boats at a distance from their base, in spite of the fact that only partial results are to be expected from such action. It should be distinctly understood that there is but one way in which anything can be done. That way is to have them accompanied by a repair and depot ship which can carry their weapons and help them to groom themselves at the end of the passage.

63. It is not believed that any successful results could be expected under the circumstances unless the boats could find smooth water at the end of the run for a long enough time to enable them to get in condition and rest the crews prior to the attack.

64. Almost every officer in the navy feels that he appreciates the severity of the service on board torpedo vessels, and all realize the fact that no crew, at the end of a long passage, would be in fit condition, without rest, to do justice to themselves or to their weapons.

65. Here again comes in the question of the adjustment of the gyroscope. Without it the torpedo is a weapon of very

doubtful value, with it badly adjusted it is even worse than without it; with it in proper order the weapon is almost one of precision, and this advantage should not be thrown away; but how are we to tell on board ship whether it is in adjustment or not? There are two ways of telling, one by putting the machine in the adjusting stand on shore, and the other by running the torpedo for an exercise run. The writer knows no others.

K. Modifications of the Theoretically Perfect System made necessary by our Lack of Boats, Officers and Men.

66. In every effort to lay out a consistent scheme of any kind in our service, we are met by the lack of means to carry it out, so that we always have to adapt our plans, which we are of course prone to consider the best, to the material available. So in this case our theoretical scheme (the main features of which the writer hopes to see in operation before his day is over) will have to be changed, probably, along the lines here indicated.

67. The less important coast districts should be included (for purposes of boat handling alone; their identity should never be forgotten, nor the effort to bring them into real being relaxed) in the neighboring districts.

68. The number of boats in a section must be reduced to five, or even three. In this case several sections should be frequently brought together for exercise. They would in time of peace be, more or less, together all the time, under the proposed arrangement.

69. The navy yards will have to be used as bases, but efforts should be made to relieve the flotilla, as far as may be, of the many papers and much routine of the big navy yards.

70. Where men and officers are lacking to keep all the boats going, a large crew should be assigned to each section, and they can go from boat to boat and care for them all, taking them out for exercise in turn. The writer wishes, in this connection to utter a most impassioned protest against the custom of laying these boats up with only the ordinary navy yard care. They cannot stand it, and the ruin of the flotilla will result if it is largely resorted to.

71. Here, as in some other parts of the paper, it does not seem necessary to go into further details. Those will adjust themselves as work progresses.

L. Types of Boats and their Standardization.

72. In regard to the styles of boats most available for general service of the nature indicated, the writer recognizes but three types that can be advantageously employed. They are:

(a) Torpedo-boat destroyers.

(b) Torpedo-boats of the type described below.

(c) Torpedo-boats to be carried by ships.

73. The destroyers are here regarded, for our purposes, as the highest type of torpedo-boat, and their use has already been indicated. The ones we are now building are of a little over 400 tons displacement, a little under 250 feet long, about 24 feet beam, and a mean draft of about 6½ feet, with a speed of about 30 knots. This seems a serviceable type for our purposes.

74. It is thought that the best type of torpedo-boat would be something between the Du Pont and the Morris. The Du Pont is rather long for easy handling, being 165 tons, 175 feet long, 17¾ feet beam, 4¾ feet mean draft, and 28.51 knots speed. The Morris is somewhat smaller than necessary, being 105 tons, 138 feet long, 15½ feet beam, 4 feet mean draft, and 24 knots speed.

75. The writer believes that if a boat larger than the Du Pont is desired, it would be well to use a destroyer, and there is no object apparent in building smaller than the Morris. It is not thought that the Mackenzie would be any less distinguishable at night than the Morris, and the difference of draft is not of sufficient importance, in the writer's estimation, to warrant the loss of seaworthiness consequent upon the adoption of the smaller types.

76. The only argument the writer can find in favor of the Mackenzie, McKee, Talbot, Gwin class is that they can go through the canals. Under our present treaty with Great Britain, in regard to the maintenance of war vessels on the great lakes, this is perhaps an advantage. It is believed that the transportation of the larger boats by rail could easily be contrived in case of necessity, and it would certainly be a most wise thing if experiments in that direction could be carried on. This would at once do away with the one advantage possessed by the smaller boats. It may be said that in the two Herreshoff boats of this type (the Talbot and Gwin), which are beyond

question the best of the four, their advantages in regard to capacity and weight are gained by the use of only a single boiler, which makes the boats so liable to a complete breakdown that they are not fitted for independent action of any sort. In other words the Herreshoff boats have been made unsafe in order to make them light and speedy.

77. The writer does not believe that standardization of types can be carried to the lengths that some authorities expect. It is not thought that the crew of one boat could transfer to even a sister boat and successfully operate her without previous experience with the particular vessel. The familiarity of the men with the particular boat they are to operate is thought to be of more importance than all the standardization possible, when coupled with a familiarity on the part of the officers with the other boats and officers of the section. Standardization is a most excellent thing, and the writer does not wish to be understood as decrying it, but a valve may be built just like another and still the two may be very individual in their action in such mechanisms as we are called upon to deal with in the torpedo business. Torpedoes cannot be so built that familiarity with a type will qualify a man to operate with certainty all the individuals of the type, and the same applies with more or less force to boilers, engines, etc.; and, last but not least, compasses.

78. In regard to speed, the writer doubts the advisability of building for such high speeds in small boats that weights have to be unduly reduced. It is thought that a sure 25 knots available on short notice, with solid, reliable machinery, is better than 30 knots which can possibly be attained but which brings with it a fair chance of breakdown. The length of time in which the extreme speed will be employed is not so very great, and the difference between twenty-five and twenty-eight knots, for that interval, will not amount to much. The Morris type, increased slightly in size, seems to be a good one.

79. The submarine boat is hardly far enough along for serious discussion, but the type certainly offers the perfection of coast-defense torpedo work. The Holland Company seems to have a very good boat, but further trials are awaited with interest.

80. In this connection it may be well to refer to what are known as the "freaks" of the navy. After a careful examination of the Katahdin, the writer believes her to be a most valuable adjunct to the harbor-defense fleet. As a part of a night

attack upon blockading vessels, which must of necessity be at a low headway, a vessel of her type (with more speed if possible) would be a most dangerous factor. Presenting in the approach almost no target, what there is being eighteen-inch armor, and hence impenetrable to secondary battery shell, and with the low chance of a hit from heavy guns at night, it is firmly believed that an attack would stand every chance of success. Certainly with several of that type in New York harbor, together with say twenty torpedo-boats, all in the hands of determined officers and men who are thoroughly familiar with their weapons, the chances of occasionally striking one of an enemy's fleet in the neighborhood would be most excellent, and the presence of such a flotilla would be a most powerful deterrent upon hostile action, to say nothing of the drag it would be upon the hostile personnel.

81. The Vesuvius has yet to prove her usefulness, but it would be of interest to try a torpedo-boat with one of these guns on board so arranged that great range is not sought; in other words, to take the weapon out of the gun class and regard it as a torpedo of superior range and accuracy.

M. Types of Torpedoes.

82. Prior to the adoption of the Obry gear, the writer was a believer in the Howell torpedo, because it undoubtedly ran through to the point for which it was aimed, something which no other torpedo could be depended upon to do. Now, however, the gyroscopic steering gear gives to the compressed air torpedo practically all the advantages of the Howell, while retaining its own particular good points.

83. The Whitehead and the Schwartzkopff are the two best known and most successful automobile torpedoes; and, without discussing the relative merits of the two, it may be said that a torpedo can now be made use of in service which shall carry about 130 pounds of explosive at a speed of 30 knots for 800 yards with extreme accuracy under all conditions of firing (provided the weapon is in proper order) with an initial air-flask pressure of 1500 pounds per square inch, and which will run accurately for 1000 yards at a speed of 28 knots. The difficulty of keeping the gyroscope in adjustment has been touched upon elsewhere. With it, the torpedo can be launched, from a fixed

submerged tube for example, and then be made to change its course after firing and take up any desired direction within reasonable limits. These statements are of what has already been done and not of possibilities. It will be seen, therefore, that the torpedo, within the limits claimed for it in this paper, has made great strides towards becoming a weapon of precision, and is no longer a thing which the enemy can afford to disregard.

N. The Bearing upon the above Statements of the Lessons of the Spanish War.

84. It is believed that the arguments herein advanced are all borne out by the occurrences of the late war with Spain.

85. The Spanish torpedo-boat flotilla went to the Cape Verde Islands, and there the scheme of bringing the smaller boats across had to be abandoned. The idea was wild from the beginning. The three destroyers came over with the fleet and were from the start a drawback and not an advantage, and when they arrived one of them had to be left in Martinique broken down. The other two were in doubtful condition. Whenever they appeared before our ships in the day-time they were quickly put out of action, and they never did come out at night. So they really accomplished nothing. The conditions at Santiago were exceptional, in that our fleet was allowed to keep the only exit, a very narrow one, brightly lighted at night. That the inertia of the forts allowed these conditions to prevail and the destroyers were therefore unable to even attempt anything is no just argument that under proper conditions they could not have done their work. No fleet could keep a proper flotilla from coming out of New York harbor for instance, and the presence of such a force within would certainly have the very greatest effect upon the conduct of the blockade. The writer is firmly convinced that the successful torpedoing of a large ship under these circumstances would be no infrequent occurrence.

86. From our own point of view in the war, the fact that the torpedo-boats cannot be used as cruisers and despatch-boats and blockaders and still retain their efficiency was amply proven. The fact that a few of the boats were carried through the war without breakdown owing to the superhuman efforts of their personnel and other causes does not lessen the force of the argument. In the same way the fact that the boats did not go into

the narrow harbor of an enemy, facing certain destruction from the heavy boom that was certainly to be found across the entrance, is no proof that they could not have come out of their own harbor. In point of fact, by the time the thing could have been attempted, our flotilla was so broken down by other uses that it would have been very hard to have gotten together a sufficient number of boats to make the effort.

O. General Summing Up.

87. To sum up, it may be said that under the circumstances here pointed out as favorable for torpedo warfare, with the modern types of the weapon, the writer is confident that success is more than likely to follow a daring effort by experienced men. To have men and implements always at the highest point of efficiency should be our great aim, and this cannot be done except by keeping the vessels in commission and their personnel at work.

88. As has been said before, there seems now to be no definite scheme or policy laid out, and it is hoped that criticism of the points here set forth may develop something towards which we can look as an ideal and which we can struggle to attain.

89. And here it may be of interest to give some historical facts as to the use of the automobile torpedo. Full accounts of the actions may be found in "Ironclads in Action," by H. W. Wilson, and there it will be seen that the results here given have been generally attained under disadvantageous circumstances. Of course the weapons employed were in no case fitted with the gyroscopic steering gear.

90. May 29, 1877, the English Shah fired one Whitehead torpedo at the Peruvian Huascar, but it had not power enough to run the distance.

91. December 27, 1877, the Russian Tchesme fired a Whitehead torpedo at the Turkish Mahmoodieh, and the weapon ran straight but exploded before reaching the target. The Russian Sinope fired another at the same time, but it failed to explode.

92. January 25 1878, the Russian Tchesme and Sinope fired one Whitehead torpedo each at the Turkish guard ship at the entrance to the harbor of Batoum, both of which exploded under and sank the Turkish vessel.

93. January 27, 1891, a torpedo launch from the Chilian

Blanco, in revolt, fired a Whitehead at the Balmacedist armed steamer Imperial, but missed her.

94. April 23, 1891, the Chilian government vessels Lynch and Condell attacked the revolutionary fleet in Caldera Bay and fired five Whitehead torpedoes, one of which sank the Blanco Encalada.

95. May 14, 1891, the Condell and the Lynch again attempted to surprise the revolutionary ships, but could not get near enough to fire.

96. April 4, 1894, the Brazilian government vessels Gustavo Sampaio, Alfonso Pedro, Pedro Ivo and Silvado attempted an attack on the revolutionary flag-ship Aquidaban, but were repulsed before they got within torpedo range. The next night they tried again, and one of the four torpedoes fired sunk their adversary.

97. July 25, 1895, the Japanese claim that in time of peace the Chinese Tsi Yuen treacherously fired a torpedo at the Naniwa, but missed her. The Chinese deny, and probably truthfully, that this ever occurred.

98. September 17, 1894, at the battle of the Yalu, the Chinese fired several torpedoes, but all missed.

99. January 30, 1895, sixteen Japanese boats attacked the Chinese fleet in Wei-hai-wei, but failed.

100. February 4, 1895, at the same place, the same attempt was repeated, and again failed.

101. February 5, 1895, the attempt was again made, and as a result the Ting Yuen, Wei Yuen and Lai Yuen were sunk at once, and the Ching Yuen was so disabled that she sank not long after.

102. It is seen here, leaving out the doubtful case in which the Japanese claim a breach of peace by the Tsi Yuen, and followed it up by a savage attack on her, that out of eleven attacks, four succeeded, resulting in the destruction of seven vessels. And this was with weapons far inferior to those of to-day and under adverse circumstances, as a rule. The moral is that there are immense possibilities in the torpedo, and we cannot afford to neglect them. We must have a policy and must follow it, and the sooner the service awakes to a fuller appreciation of the chances offered by this weapon the better we shall be prepared with a warm reception for any hostile visitors to our coast.

DISCUSSION.

Captain C. F. Goodrich, U. S. N.—The prize essay of this year impresses me as a peculiarly logical endeavor to solve an important professional question. Personally I cannot pretend to sufficient familiarity with the details of the subject to pronounce judgment on the answer found, but as the steps in the argument are based on the solid ground of experience I am content to accept the result.

It is only by careful study of tactical needs that a satisfactory building programme can be evolved. We are too ready to adopt new types of vessels simply because of their appearance in foreign navies or because of some ephemeral wave of public opinion at home. Had we approached the larger matter of ships in the thoughtful manner of the essayist we should not have now to regret the expenditure of vast sums in certain constructions for which no place exists in the fleet. I think the essayist's method deserving of the highest praise and I cannot refrain from expressing the hope that the same method may even yet be applied to the working out of ship types. We should build nothing whose functions and employment are not demonstrated in advance by careful study of our necessities, and the lessons of the past—nothing of which the position in the fighting line or among the auxiliaries is open to any shadow of doubt. Thus only shall we have a homogeneous navy; thus only can we cease to produce an assemblage of craft to which the unhappy term of "job lot" is applicable.

Captain C. F. Goodrich, U. S. N.—I have read Lieutenant Chandler's essay with much interest and great profit. If I venture to criticise, I hope I may be understood as attacking the one point wherein I think the writer has fallen a victim to the allurements of an ever present siren. Were he to cast his eyes about him he would find himself in extremely good company—I had almost said the very best, for among those who share his views are certain officers of great distinction and exceptional mental capacity.

I will only touch upon his Section (C). To be brief and to the point I must say, with perhaps brutal frankness, that I differ with the writer *toto coelo*. The underlying idea of this section violates, in my judgment, every historically sound maxim of naval strategy. The motto *divide et impera* is to be applied, not by ourselves to our own resources, but by an enemy who would gladly see us do exactly what the essayist proposes.

The mere fact that we should require one hundred and seventy-five boats with say an average of three officers each, or five hundred and twenty-five line officers, more than one-half of all the commissioned officers we now have on the active list, shows how impossible of realization is such a scheme as this, even if it were desirable. We can only succeed in war when the fleet in all its branches is controlled by one man. When hostilities break out, our Commander-in-Chief's first move would be to

concentrate his forces and not to dissipate them in the manner set forth in this essay.

To localize our defenses is a favorite plan with many, but feeling so strongly on the subject as I do, an earnest protest on my part is in order and seems to be imperative.

"Torpedo Craft: Types and Employment."

Captain Asa Walker, U. S. N.—The masterly manner in which this subject has been treated by the essayist, and his logical deductions from the accumulated data have served to make up a paper of great interest and value to the service. The main and vital features set forth cannot fail to receive the assent of all interested in the subject.

The question as to the displacement of the Destroyer, may possibly not as yet have reached to the point of solution, but there can be no doubt as to the fate of the smaller torpedo-boats.

I look upon the suggestion of replacing the one-pounders by six-pounders as most sensible, and its adoption would be a step in the right direction.

I fear that the so-called sea-keeping powers of the 165-ton torpedo-boat will prove delusions, and that their use will be confined to home waters or cruising in summer seas. Even there life on board will be hard enough for their crews.

I am glad to see so much stress laid upon what are oftentimes considered minor details, comfort and convenience for the personnel. These, to my mind, are quite as essential, especially in protracted operations, as speed and power of offense. However perfect may be the weapon of warfare, it is, after all, upon the brain directing it, that the effect depends. So intimate is the relation between body and mind that the weariness of the one leaves its trace on the other. To be sure that the brain is acting up to par, it should be seen that the body be not worn and weary. To this end every possible convenience should be given to crew and officers.

Unfamiliar as I am with the internal arrangements of the boats, I doubt not that the suggestions of the essayist are all valuable and to the point, yet perhaps some other torpedo man would desire other devices. How would it do to convene a board consisting of four line officers, who had had experience on the boats, one of whom, as an engineer, and one naval constructor. The duty of this board to be confined solely to internal arrangements for comfort to crew, and convenience of stowage for equipments and supplies. The approved report of such a board would standardize the living quarters, if carried into effect.

I fully agree with the essayist on the importance of keeping the torpedo fleet on a service footing, at all times, and of requiring regular and constant drills. It might be practicable to make partial changes in crews, at stated intervals, so that the boats would become schools to the general service, to a limited extent. This should not be carried to the extent of hazarding the efficiency of the torpedo fleet.

The thanks of the service are due to the author for so clearly stating its needs as well as pointing the way toward their realization.

"The Automobile Torpedo and its Uses."

Captain Asa Walker.—The logical and earnest manner in which the essayist has treated his subject, demands of the thinking minds in the service, the highest appreciation. Any attempt at criticism from me would indeed be to "rush in where angels fear to tread." The organization proposed seems most excellent and greatly to be desired. The appointment of a chief of the flotilla, with specified duties pertaining thereto, would seem to be the first natural step to a systematization of the service. The division of the coast into districts, with the detail of torpedo sections to the respective areas presents features of the most pronounced utility.

The essayist's plea for full crews for the boats, *at all times*, will meet with the unqualified assent of all service men, who have given the subject a thought. His arguments with regard to the personnel are well founded and convincing. It is self evident that however good may be the boat and the torpedo, if "the man behind the gun" be untrained the result of action will be disaster.

There would seem to be little prospect that the torpedo-boat or the destroyer will be called upon to act across the ocean, but both should be prepared for service in our West Indian possessions and dependencies, for there will probably be the field for our future naval conflicts.

I am of the opinion that the essayist takes a pessimistic view of the danger attending the delivery of a torpedo-boat attack when he says: "No one can go out expecting to return." This view is not upheld by the summary of such attacks given. Not all members of the forlorn hope are killed. While a torpedo attack may be looked upon as the most desperate of naval encounters, yet even in defeat, it cannot mean death to all engaged—though looking death in the face, he who thus engages should feel that in success lies his greatest chance of escape, and fix his whole mind on the achievement of that success.

As the essayist says an organization of some kind is imperatively needed, whose details can be worked out later, meanwhile the service should thank any one, who pushes this need to the front.

I feel that my personal thanks are due to the essayist for the pleasure and profit found in his admirable paper.

Commander F. J. Drake, U. S. N.—Lieutenant Jackson has treated the subject of torpedo craft, types and employment in a very clear, concise and practical manner.

Following carefully the results which have been obtained by England, France and Italy in experiments and the development of torpedo-boats as a factor connected with fleet manœuvres, they have not as yet produced any definite results, with regard to the size of the different classes of torpedo craft, which practically will combine an offensive and defensive line of attack in connection with a fleet.

It is to be observed that every time any fleet manœuvres take place the torpedo-boats as a rule invariably break down, if kept at sea for a few days only; thus defeating the carrying out of their part of the programme as a factor in the unit of offense or defense.

I thoroughly agree with Mr. Jackson that during the late Spanish-American war our torpedo-boats performed every duty, except the one for which constructed, and that duty not with complete success, owing to the frail structure of the boats, their want of sea-going qualities, cramped quarters, lightness of machinery; to say nothing of the hardships endured by the officers and crew, their skill and seamanship displayed in keeping afloat, while so gallantly performing their part of the trying ordeal. The impossible has been attempted with torpedo-boats by all nationalities, with the result that the object sought has not been accomplished beyond a doubt, either in practice trials at sea or in action. In my opinion, the failures being due to the limited displacement for the so-called sea-going class, high speed required (which by the way is never maintained with satisfaction under cruising conditions calling for emergency action) consequently light structural strength of hull and engines.

I concur with Mr. Jackson in a division in three classes for torpedo-boats, but the destroyer class should be capable of keeping the sea for ten or fifteen days under a cruising speed of twenty knots, if necessary. The sea-going class of torpedo-boats to be limited to a radius of action of one hundred miles from their port, and then only under conditions of weather in which they are fully equipped for immediate attack, and not with everything stowed below for safety and stability while outside. Station boats to be used entirely for harbor and inland water defense. These to vary in tonnage up to 200 tons, as circumstances require.

The destroyer class to range in tonnage from 1000 to 2000 tons; to have a cruising speed of twenty-five knots; maximum about twenty-eight knots; to be able to maintain their cruising speed as long as their coal supply lasts; to have a protective deck, with living quarters above; in construction to be composed of plates and frames of not less than ten pounds; no water-tight doors in bulkheads; compartments below protective deck to be accessible through water-tight shutters in the protective deck; the shutters to be surrounded by cylindrical water-tight trunks, the latter fitted with water-tight doors and constructed on the protective deck, independent of the upper deck and frames; the shutters to be mechanically operated from the compartments which they close; twin screws; engines to be of the quadruple expansion type; water-tube boilers with all modern improvements; buoyancy and floatability not to depend upon that portion of hull above the protective deck; to carry two torpedo tubes in light spheroid revolving turrets on bow and quarter lines with above-water discharge; armament to consist of a limited number of six- and twelve-pounders; draught not to exceed twelve feet; the living quarters and out-of-the-water part of the hull to be built on to the protective deck; the latter extending the whole length of the vessel.

Destroyers of this type would be able to go to sea; carry their crew and officers comfortably; live out all kinds of weather; be self-supporting, sea-going boats suitable for our long line of coast where harbors are far apart. These vessels will be able to overhaul similar torpedo-boats of the so-called sea-going type, although the latter may have a higher maximum speed (determined over the measured mile), which can be maintained for a

very short time only. When pushed by a destroyer of this class capable of cruising steadily at a twenty-five knot gait, the so-called torpedo-boats will very soon break down, and thus be overhauled and destroyed.

It must be considered that so-called torpedo-boats of high speed, cruising at sea for a few days, lose a certain amount of their efficiency by virtue of the wear and tear on the engines and crew. Should they, under these circumstances, fall in with destroyers of the type mentioned, having sea-endurance limited only by their supply of coal, the torpedo-boats under the most favorable conditions of weather, in my opinion, would become an easy prey in a very short chase; hence I advocate destroyers of this type.

Taking the battleship as a unit, two destroyers will become its consort. For our coast defense and possessions in the West Indies, as well as future protection of the approaches to the Nicaragua Canal, we would have a defensive fleet protection of the battleship type without a parallel.

Sea-going torpedo-boat type. The sea-going torpedo-boat described by Mr. Jackson under Class "P" then fulfills all of the requirements for an off-shore harbor defense in connection with the fleet. I should, however, build these boats with heavier frames and plates, increasing their displacement to between three and six hundred tons, with a twenty-knot cruising speed and a maximum of twenty-five knots for six hours at least. The armament and other conditions described are excellent. Clear decks are essential with the exception of hatches, conning towers and launching tubes. Gangways around hatches, however, could have a light hand-rail, stanchions of iron, with rope rail rove through the eyes of the stanchions.

In deck coverings I should advocate gratings, half wood and half papier-maché. This would be better, lighter and more durable than wholly made of wood.

Concerning Charts. The Hydrographic Office should get out a set of Coast Pilot charts for torpedo-boats made in squares of about eighteen inches. These should be pasted on stiff backs with a compass on each section of chart; the sections numbered in rotation, which are necessary to make up the present whole chart by an addition to the present number of the chart, put on the back of each section: For instance, "A-1," "A-2," "A-3," etc. For example, "Chart of the Straits of Florida, including Florida Bay" could be divided into four sections; each section would be marked on the back with catalogue number, No. 15-A-1, No. 15-A-2, No. 15-A-3, No. 15-A-4. The backs of such charts, being shellacked, will be protected from the weather and prevent warping. They can be easily stowed and handled under these circumstances, when placed alongside each other in the order of sequence, fulfill all the requirements of the larger chart, and this under all conditions of weather, especially in cramped quarters.

With regard to air compressors: in order to overcome the great difficulty which was experienced with our torpedo-boats during the late war, in the bulging of the sides of the cooling tanks of the air compressors, due to excessive pressures, the introduction of a pressure regu-

lator and relief valve attachment to the compressor circulating pump, as proposed in the Fox and Davis will be found beneficial, where suction is through one outlet, both for the circulating and compressor pumps.

Lieutenant Jackson's remarks with regard to the torpedo director are not only logical, but practically correct. It would be well to go further and say that torpedo directors are of use only to a torpedo officer in a battleship or armored cruiser carrying torpedoes, who is directly and solely giving his attention to the range and bearing of the enemy from his point of lookout. In conning towers of vessels of all description, they are not only a nuisance, but a hindrance to the proper functions of the conning tower, because of the impossibility of any commanding officer or other person who is engaged in conning the ship in a fight to give his attention to any other duty. If he does so, the space passed over by both ships in the meantime so changes their relative positions that he loses sight of the vantage point of the best fighting position for himself with reference to the enemy. The functions of conning towers in all vessels should be given to steering wheels, engine- and steering-room connections, indicators and communications, and no other. These are all one head, in the present age, can clearly and intelligently manipulate at one and the same time, where seconds involve relative changes of positions of combatants of such magnitude that the result will be disastrous to one or the other in a few minutes of an engagement. These are conditions in which when closing with an enemy the battle becomes decisive, of short duration and much relief to the victors.

Steering Engines. These should be of the same type in all boats under the destroyer class. They should be compact, light, and should occupy a limited space of not more than fourteen inches square. Engines of this type have been fitted in the Fox, Davis and Goldsborough. They are light, handy and have perfect control.

Guns on torpedo-boats and destroyers should be mounted so as to have an all-around fire, exclusive of smokestacks, ventilators and masts. They should never be compelled to change the course of the boat running at high speed and lose distance, in order to bring the battery into action. When approaching to launch a torpedo, the crews should never be at the guns. The latter should be manned only in case of defense for protection from the destroyer class, or for bringing-to similar boats or clearing the approach to the beach for a landing party, when not opposed by masked or other shore batteries. The question of an attack upon a superior depends upon the probability or chance for a swimming match. In the daytime torpedo-boats will have a greater moral effect in the presence of or near an enemy by keeping out of sight.

Their original design and construction was and is only intended for night attack and then under the most favorable circumstances of weather and total darkness. Never less than two boats should attempt to attack a superior vessel. The attack should then be from opposite bows or quarters and should be simultaneous. This condition will be the most harassing to the object attacked, while insuring the greatest safety to the torpedo-boats. The unit of action in all manœuvres should never be less

than two boats and these should always function together. One is a stimulus to the other, and two cool heads are better than one in outlining any action of this character. All tactics for torpedo-boats should be developed on this base. They should always exercise, cruise, scout, plan and fight together.

Under such circumstances and from observations which I have made of manœuvres of vessels of this class, this appears to be the only clear solution for reasonable success in action.

Torpedo-boats should never be convoys to a battleship, except when the latter is at anchor or underway within their sphere of action; that is, in harbor or within a radius of twenty-five mile limit to the entrance of the same. Battleships cruising, should each be accompanied by two destroyers, as outlined, of 1000 to 2000 tons displacement. Then will the commander of the battleship be the better able to control the immediate action of his own vessel in all conditions of weather, and not be borne down with anxiety for the safety of his consorts. He will then feel safe and strong, not only in the conviction, but in the fact, that they can live and fight with him in any weather in which he may desire to make an attack.

The details of equipment, officers, distribution of boats, drills, etc., have been very clearly outlined by Mr. Jackson, and further comment thereon can only be brought out by practical applications of his suggestions and results obtained.

"The Torpedo-Boat, Destroyers, and Depot." P. 851, No. 92.

R. C. Smith.—I am warmly in accord with Lieutenant Koester as to the desirability of the early establishment of a torpedo-boat depot. The subject was very fully discussed by Lieutenant Ellicott three years ago in the Institute Proceedings (p. 441, No. 83). He there enumerated seven requirements in locating such a station, and I can think of no other to add to them—and found that they would all be satisfied near Peconic Bay, Long Island. It is certainly an ideal location, as every one who knows it cannot fail to realize. Navy yards are the last place for such a depot. As a rule there is not room and the boats are in the way. Then there is no one specially interested in them, since the principal work is in connection with larger vessels. Such work as is required to keep a boat in ordinary repairs does not necessitate a very extensive plant. The machine shop needed for work on the torpedoes would also answer for most of the work required on the boats.

The expedient of hauling boats out for storage is open to argument. Abroad, it has been found that it strains the boats and gets the machinery out of line. It is possible that a fresh-water basin and small floating drydocks for lifting the boats when it became necessary, to sight the bottoms might be preferable.

I am not convinced of the impossibility of the crews of boats in regular commission living on board with a fair degree of comfort. In my own experience it was possible under peace conditions; under war conditions it would be necessary. Men and officers are not apt to take

the proper interest in a boat unless it is also their home. This for boats in commission: for those in reserve, a necessity perhaps that we may have to admit, though I agree with Lieutenant Koester it would be better to keep them all in commission, a single crew could man four or five boats and keep them all efficient. This crew could of course live in barracks.

I think I am also in accord with him as to two types being sufficient, leaving out, of course, vedettes. I wish the requirements of inland navigation did not limit the size of destroyers so absolutely. About 300 tons is as large a boat as can use these passages. (Does not refer to the Erie Canal.) Our largest boats cannot go through the canals. To be sure a destroyer is expected to accompany the fleet, and it may never be necessary for one of them to make an inland passage; but the capability of so doing, if necessity did arise, could not be an undesirable quality.

It is a pity, however, that there is not some other necessity which would make it impossible to increase the size of our destroyers any further. I think the requirement of invisibility should do it, but that does not stop the designers and builders. The gradual increase in size of destroyers, abroad as well as at home, threatens to duplicate the experience of the English with the now discredited torpedo-gunboats.

"Prize Essay, Torpedo Craft: Types and Employment."
P. 1, No. 93.

R. C. Smith.—Lieutenant Jackson's essay is the fruit of three or four years' actual experience with several types of torpedo-boats. It offers exactly the sort of information most needed in designing new boats and perfecting old ones. After a new ship or boat has been a year or two in commission, her officers and crew know pretty well what there is about her effective and serviceable and what is impracticable or a failure. If this knowledge could be card-catalogued and made absolutely available for future designs, there would be a steady improvement in equipment and fittings of all kinds. There is no doubt a great deal of such information on file available in large ship designs; for torpedo-boats probably much less. Therefore every paper of the character of this essay is a positive addition to knowledge.

I agree very generally with the views expressed and consequently will refer to only a few points in regard to which there is still room for argument. I should add in regard to air-compressors that in view of the frequent failure of these machines, two small ones might be better than one large one. Cases could be imagined in which two air-compressors might be almost as essential as two engines.

The classification of boats by the letters O, P, Q, R, is intelligible and offers a good basis for discussion. The essayist finds places for all the types except Q, the boat of 100 to 150 tons. I have advocated hitherto O, Q, and the smaller vedette type of R, hence we are substantially in accord except as to P and Q.

Now the argument for P as opposed to Q is derived in the main from the Spanish war experience. P performed all that was required, Q was found deficient. Could not this result be due to the fact, admitted

by the essayist, that the principal work required was despatch-boat duty and not torpedo-boat duty? P certainly has greater sea-keeping qualities than Q. The only objection I make to her is her larger size, and hence greater visibility. As her chief mission is the torpedo attack pure and simple, it seems to me that invisibility is an imperative desideratum.

Now as to operating in the West Indies: I hope we shall always have there several stations and bases. We certainly shall in Puerto Rico; perhaps we may in what are now the Danish West Indies; and even after Cuba becomes independent she will no doubt always grant us stations. Hence if class Q will answer for temporary service with the fleet on our own coast, it probably will also in the West Indies. In bad weather it will be able to seek shelter in either locality. Class O, however, the destroyers, will be the principal type for independent sea-keeping, not only with the fleet, but often for detached work, if we can manage to build enough of them.

In the next war the temptation will be to use these craft for despatch-boat duty just as we did in the last, and in fact there will be no help for it, unless in the meantime we build special despatch boats. I had thought to see several of them authorized at the last session of Congress, as the war had shown a crying need for them. A boat of 1000 tons, on the lines of the destroyer, and with the same speed, no torpedoes, a very light battery of semi-automatic guns, sufficient to protect her from destroyers but no more, then all the rest of the available weight and space given up to boilers, machinery and coal (preferably liquid fuel); such in brief are, to my mind, the requirements for a despatch boat, and we ought to have a number of them as early as possible.

As to the ordnance outfit of the torpedo craft, I believe the correct principle is more and smaller guns, within limits. A one-pounder is practically of little use. A three-pounder will penetrate to all parts of a destroyer or torpedo-boat. I believe then that more three-pounders and more ammunition are preferable to the same weight in six-pounders and their ammunition. The question is not complicated here by armor. The objective is the personnel and the boilers and machinery. The more shots there are, the more chances of effective results; and for that reason three-pounders appeal to me more than six-pounders. I believe also that one or two guns of the Colt pattern would be found useful against the enemy's personnel.

I have already written something about laying up the boats in a discussion of Lieutenant Koester's paper. If it has to be done, I should prefer a fresh-water basin. Rather than that, however, I should turn them over in large numbers to the naval militia organizations. What matter if some boats are injured? The militia will have to be depended on to man most of the smaller ones in time of war, and to do this it is of course necessary for them to have practice in time of peace.

There is evident a tendency to call a halt in torpedo-boat construction. The only apparent reason for this is an impression that has gone abroad as a result of the Spanish war. Torpedoes seem to be discredited. Our boats accomplished nothing, the Spanish boats accomplished nothing.

The only chance for our boats would have been Santiago; but in view of the character of the entrance it would have been almost certain suicide for a boat to have gone in. The attempt was not warranted, considered either before or after the event. As to the Spanish boats, or destroyers; they made no night attacks and were quite easily disabled or destroyed by daylight. Their real mission, indeed, was not to attack ships, but to defend their own ships from the attack of our torpedo-boats. Notwithstanding, if those destroyers had had American crews under similar circumstances, they would have found a way out of Santiago harbor by night. They might have perished, but that is all they accomplished anyway. There is no other evidence than this. Yet through the country at large, and even through the service, there is a very comfortable feeling, that there is not so much in that torpedo-boat nightmare after all.

There may be another reason for not building torpedo-boats at present, that we have no officers or men to man them. Would it not be possible to authorize a minimum number of officers and men for the service, bearing a certain relation to the number of vessels at present available, then whenever a new vessel was authorized add to all the grades and rates enough officers and men to man her? For instance, it is easy to determine what our present strength should be. We have only to assign suitable complements to the vessels on the Navy list and those authorized, with a fixed proportion for reliefs and shore duty. Now a new vessel is authorized; could not the same act authorize the addition of a suitable personnel in the proportion established, less the numbers already available by reason of vessels crossed from the list? The present Navy bill is said to provide for two battleships, three armored cruisers, three protected cruisers and four gunboats. The complements for these vessels, considering only line officers and men, with twenty-five per cent additional for shore duty and reliefs, are estimated at 10 captains, 35 lieutenant-commanders, 135 lieutenants and ensigns, and 5750 enlisted men. Could not these additions to the personnel be authorized at the same time? There are probably some objections, but it is doubtful if any of them are insuperable. Notice that all additions to the various grades are made in the exact proportion of the numbers needed for duty. As to filling vacancies at the foot, if the proposed four years' course at the Naval Academy, with the additional presidential and senatorial appointments, does not supply enough candidates, then an appointment could be made from each Congressional district every three years, and eventually every two years, keeping the course at the Naval Academy four years or any number of years that might seem advantageous.

"THE AUTOMOBILE TORPEDO AND ITS USES." P. 47, No. 93.

R. C. SMITH.—It was a fortunate thing that the two principal contestants for the Institute prize this year should have selected subjects so nearly akin. Their papers, both the result of personal experience, round out a subject that is timely and important. To the men who have been at all interested in torpedo work, the value of the arm seems greater

now than ever. For some reason, as I have mentioned in a discussion of Lieutenant Jackson's essay, an opinion seems to have spread abroad, even in the service itself, detrimental to a continuous steady development of this form of warfare. These two papers will do much to dispel this illusion.

Lieutenant Chandler's views on the individualism of torpedoes and especially torpedo-boats are peculiarly apt. Any man who has had experience with more than one boat is profoundly impressed with these facts. Standardization in groups is valuable for two reasons, first for facility in repairs and the supply of spare parts, second for similarity in manœuvring powers for group action. That any amount of standardization will ever enable a crew to shift from one boat to another and be entirely familiar with her on the first trip is clearly impossible to those who have had experience. It is not realized by others and it is very well brought out by Lieutenant Chandler.

I also am a little skeptical as to the possibilities of the German wedge formation for attack in any except perfectly calm weather. No doubt, however, it can be opened out a little under other circumstances. If the enemy's location is absolutely fixed and known, concerted attacks can be made without a group formation. If the enemy has to be sought out, the group is necessary; and it will be well for us to practice the German method or devise one of our own.

This is now what we need more than anything else, practice with all the boats that are available. If we have not enough officers and crews, cannot Congress in its present generous mood to the Navy be induced to remedy the defect? There are three problems that ought to be worked out at the earliest moment. One is the group formation for cruising in search of the enemy, as already mentioned. Another is the method of getting through the enemy's picket line. The only way to determine this is to devote a week or two when the squadron is at Newport this coming summer to an exercise at a thorough defense by pickets, vedettes, and destroyers; and an attack by torpedo-boats and destroyers. It may be explained briefly that I understand by pickets the pulling boats of the squadron and by vedettes its 50- to 60-foot fast launches, of which we have none, though there seems no question that they should be carried by battleships and large cruisers. Pickets and vedettes can be used ordinarily only when the squadron is at anchor, destroyers at all times. The third problem is the possibility of disabling the boats by gunfire after they are discovered. A practicable way to accomplish this might be to have a destroyer tow a light target resembling a torpedo-boat at the end of a long steel wire. The destroyer would steam at high speed and pass directly ahead or astern of the vessel attacked. At a given signal the search-lights would pick up the target and the secondary battery would open up, firing for a given number of seconds. This idea, as far as I know, originated with Captain Evans. It promises valuable lessons.

I hardly believe that second-class boats aboard ship or torpedo-depot ships will be useful in the future. The question is too long to discuss here, but I went into it rather fully in a paper published in No. 81 of the

Proceedings. A general repair-ship, like the Vulcan in the late war, will prove of the greatest use to each squadron. In place of the second-class torpedo-boats aboard ship I believe the vedette launches already mentioned would be far more valuable.

I believe also that the destroyers will have to accompany our fleet wherever it goes. On a hostile shore would be just the place where they would be most necessary. It is true the Spaniards did not accomplish much with their destroyers, but they brought them over. We should hope to do better. In this connection, why is it that we have so many successful experiments with liquid fuel, and then do not hear anything more of it? The best way to introduce liquid fuel for torpedo-boats and destroyers is probably just to introduce it. If there are any defects in the methods and appliances they will soon be remedied. Think what this would mean for destroyers on a long cruise with the squadron. When they were out of fuel they would take a line and a hose from one of the big ships, and coaling would be over in ten minutes. The saving in size of engineer's force could go to more comfort, more stores and more ammunition.

I do not believe we ought to talk about modifying what we consider the best method of employing our torpedo-boat flotilla on the assumption that we shall be unable to get boats, men and officers that are shown to be necessary. Congress is favorably disposed, the press is favorable, and the people are favorable. All that is needed now is to show it to the proper authorities in the proper light.

In conclusion, I may say that I have pointed out some few details in which I do not agree entirely with Lieutenant Chandler, but with most of his ideas I am heartily in accord, and I believe that every paper of this degree of merit is bound to accomplish some result.

Lieutenant-Commander F. F. Fletcher.—There is little to criticise in this article (The Automobile and its Uses), which presents an interesting statement of the opinions upon torpedo-boat questions, and reflects the popular conception upon many of the points involved.

In much of the literature upon torpedo-boats there exists a number of ideas that are accepted without question, but which may need revision, when viewed in the light of historical data, or a more detailed analysis of the results obtained in this mode of warfare.

One of these prevailing ideas, dwelt upon by most writers, is the extreme peril attending the attacking torpedo-boat.

This is emphasized in the essay by the expression of the opinion that those who engage in a torpedo-boat attack should not expect to return, or if such an idea is seriously entertained they should remain at home. This is a very gallant and commendable spirit, but I would like to bring some facts to bear upon this point, which may afford a more encouraging view to the young officer ambitious to make a torpedo-boat attack and yet desiring to live and enjoy the honor of success.

In the battles of this last century, we find that trained troops will withstand a certain percentage of loss before demoralization sets in, and de-

feat becomes probable. The loss varies from about forty per cent, as at the battle of the Wilderness and at Leipsic, to seven and a quarter per cent at Modder River. A lost of twenty or twenty-five per cent is considered quite severe and is a satisfactory explanation of defeat. This percentage of loss refers to troops in the field, but it is a principle governing the conduct of personnel in action, that applies, except under special conditions, to any other mode of warfare.

We will now examine the results of torpedo-boat attacks and ascertain what bearing they have upon the dangers and risks involved.

Torpedo-boat warfare was inaugurated over thirty-five years ago. At that time the attack consisted of a comparatively slow-moving boat of from four to seven knots speed, which had to come in actual contact with the vessel to deliver her blow. The vessels as a rule had a broadside battery of eight or ten guns in addition to machine guns and small-arm fire. Then came the development of the offense by an increase of speed in the attacking boat to twelve or fifteen knots in addition to a towing torpedo to avoid coming in actual contact with the ship. This was shortly followed by the introduction of the automobile torpedo and greater increase of speed, until finally we have the high-speed boat and longer range torpedo, with the addition of a rapid-fire battery.

On the other hand, the development of the defense has made equal strides in advance. In this gradual development of the offense and defense it will be interesting to see how far the balance of power has been distributed since the first attack against the "Ironsides" on the outside blockade of Charleston.

During the days of the spar torpedo there were fifteen attacks by torpedo-boats, three of which took place in broad daylight and twelve at night. In one of these day attacks two ships were sunk while the two attacking boats and crews received but little injury. In another daylight attack a single boat got alongside of an ironclad and escaped without injury. The third daylight attack of two boats against a monitor was unsuccessful though neither boat was sunk.

Of the twelve night attacks, one was abandoned when the ship opened fire.

Of the eleven night attacks where the boats rushed in, eight of them succeeded in getting a torpedo alongside, two exploded against a boom and one failed.

Of the eight attacks in which the torpedo was placed alongside the ship, one failed to explode, three exploded and injured three ships, and four exploded sinking four ships.

There were thirty-three torpedo-boats employed in these fifteen attacks and the number of men employed was about three hundred and fifty.

Three boats or nine per cent were lost.

Twelve men or about three per cent were killed.

These losses were caused principally by dangers incident to the attack, but the *gun-fire of the ship* did not sink a single boat and killed only one man. On the other hand six ships were sunk, three were injured and over five hundred lives lost.

In all these attacks we cannot fail to be impressed by the amount of gun-fire the boats withstood, without being disabled or the crews demoralized, and this from ships, whose broadside fire amounted to nine or ten shots a minute in addition to small arms and machine guns.

The accounts tell of the boats being greeted with a "general fire of artillery and rifles" and a "hail of bullets," a "storm of projectiles," a "fusillade of musketry" poured down upon them.

We will now examine the results under more modern conditions presenting a marvelous change in the character of the weapons employed, in both offense and defense.

There have been nine attacks with the automobile torpedo, three of which took place in broad daylight. In one of these day attacks the boat was well within torpedo range under the rapid-fire battery of a ship in action and escaped injury.

In the six night attacks in which the boats ventured within torpedo range, eight vessels were sunk, comprising three armored cruisers, three cruisers, a tug-boat and a schooner.

In only one night attack out of the six did the torpedo fail to sink a ship, and as might be expected, this was the first attack ever made with an automobile.

In these six night attacks twenty-seven boats were employed, though only sixteen discharged their torpedoes and were under fire. One boat was disabled by gun-fire and one was lost by running aground.

About five hundred men took part in these attacks, and the loss of personnel was less than two per cent in killed, and of boats about twelve per cent.

The histories of the spar torpedo and the automobile torpedo, show them to be much alike in their operations. Each weapon has a record covering a period of about twenty years, during which time each was employed in four different wars in which seven different nations were engaged. There is the same percentage of success and failure, the same percentage of loss in material and personnel. With each weapon, about thirty boats have been employed in attack, in which about six per cent were lost in both cases, with about three per cent of the personnel. The spar torpedo sunk six ships and the automobile eight.

The figures representing the percentage of losses given above are more than a mere coincidence. They are the results of the natural balance of power that exists under normal conditions of attack between the offense and defense irrespective of weapons but regulated by that general principle of danger and risk which governs the conduct of the personnel in the battle.

Theoretical calculations, as to the chances of a torpedo-boat under a rapid-fire battery of to-day are not at all convincing, but such a calculation based upon the probable number of hits required to disable a boat, the size of the target, the time under fire, and the known percentage of hits usually made in battle would indicate results approximating very closely to the experience of the past, and that the modern boat holds the same relation to the rapid-fire battery of to-day, that the slow-moving

that—for the department's files are lumbered with such stuff; and moreover the time has not arrived for the consideration of such matters. Let us first consider what torpedo-boats are for, let us give the matter as much attention as civilians very generally do, let us decide whether or not they can fill any rôle other than the only one we now assign them, i. e., the giving of trouble and expense in providing some means for storing them away on shore, and the rest will be easy. For without boasting, I think our record of work done in the Navy is sufficient ground for supposing we would utilize torpedo-boat material very creditably if we made up our minds that we wanted to utilize it at all: and that we could even get a great deal of service out of the heterogeneous lot of boats on hand.

Whether our attempts in the way of organization, etc., were the poorest possible or the best is not now important: for any attempt in any direction must be infinitely better than our present attitude, for the same reason that unity is infinitely greater than zero.

The essayist's criticisms of details of construction and equipment are very interesting to people interested in torpedo-boats and their work. But that they can have no interest for the service at large is shown by the facts that practically all these suggestions upon practically the same details were filed in the department eighteen months ago, were issued to constructors in charge of building torpedo craft, were published in a nautical paper a year ago—*Marine Review*, March 2, 1899—as matters of interest for civilians, and were proved by the logic of events to possess no interest at all for the service. I would, however, venture to accentuate the necessity of one detail, probably overlooked by the essayist for the reason that he was considering an aggregation of single boats and only touched lightly on the matter of groups, that of proper towing appliances.

The arguments of the essayist as to battery seem to me to be entirely logical, if in his scheme of weights, the stiffening of the structure to take six-pounders has been carefully worked out.

Personally I would prefer to substitute one very low power fourteen-pounder for one of the six-pounders in torpedo-boats in order to give the boat a better chance to stop a destroyer, when the boat was at her legitimate night work. Under such conditions the extreme range at which the target could be made out would be 800 yards and for that range a poor trajectory could be put up with for the sake of the large shell power.

It is well to remember, too, that the aid to good shooting due to flat trajectory is proportionately much less in a torpedo-boat doing her twenty-five or more rolls a minute than in a ship designed to give a good gun platform.

In designing such a gun I would go at once to the most economical velocity—the velocity at which the projectile barely begins to feel the drag due to base vacuum or replacement waves—about 1000 feet I. V. And I think that it would be found that the gun would be within limits of toleration as regards weight and to be possessed of comparatively better shooting qualities under the given limiting conditions, than the high-power daylight shooting we do would lead us to imagine.

Commander W. W. KIMBALL, U. S. N.—It is very refreshing to read a paper on torpedo craft policy for the United States that covers the ground so completely and so logically as does Mr. Chandler's essay. It is very delightful to find a U. S. Naval officer with courage and optimism enough to advocate openly and without shame 175 real torpedo-boats for real torpedo-boat work; when most of us believe that the 35 of all kinds of queer ones we now have are more than we need; and that these 35 should be used, chiefly, to provide the approximate dimensions for the fine large store sheds to be built around them. And so it becomes difficult to disagree with him on small details—which I must do in order to find an excuse for discussing his well-held points, at all.

The seven-boat section he advocates is without doubt the proper group unit and one that appeals to any one who has handled grouped boats. Personally I do not like the idea of a destroyer for a section leader, because it has been borne in upon me by experience that the section commander should always have the aid of his judgment in requiring work from the boats, that is given him by being in a craft exactly like those he is handling.

We have all observed the fact that the point of view as regards sea and weather from the fine large flagship leading the van with an easy agreeable motion is quite different from the estimate of weather conditions made on board the rear gunboat jumping into it up to her smokestacks; and in torpedo-boat work where exactness of manœuvring counts for so much, it would be well, it seems to me, to eliminate all grounds for such differences of opinion.

The German wedge is an entirely practicable formation even where, from the designs and dimensions of the boats, the German distances cannot be held. I do not like the idea of barracks for crews at torpedo-boat bases because the change from comfort ashore to discomfort aboard would be too marked and because there is a practical benefit in keeping the men afloat even when tied up to a dock. The idea of the expenditure for the bases frightens me while it dazzles me with its attractiveness. And so my mind reverts to the floating base, not a Vulcan as advised in Par. 55, but the small depot and section supply ship suggested to the Board on Auxiliaries a year ago last October and recommended by the board. Such a depot ship would allow great mobility in concentrating sections and in moving them anywhere along our coast from Eastport to Galveston, or San Juan Point if necessary; and anywhere within a hundred miles of the anchorage of the depot ship the section could keep itself tuned up and ready for work in all respects, save docking. The depot ship would supply the machine plant, the sick-bay, the spare parts, the reserve pumps, the clothing, etc., beside the fuel, oil and waste supplies.

Depot ships would be much more economical than the fine shore bases advocated, and while much less satisfactory in certain directions, would be better for many tactical reasons, and for a tremendous practical reason in the eyes of torpedo-boat men—she could carry two or three hard working clerks aboard her, who could make out the absolutely necessary reports and returns and requisitions.

Being a submarine-boat crank of fifteen long discouraging years' standing, I of course, cannot agree that the submarine boat is hardly far enough along for serious discussion. Most assuredly it was most seriously discussed abroad a half dozen years ago when the European technical and service publications did me the honor to discuss a paper of mine on the technical value of the type; and there are cheering indications that we, too, will awake to its possibilities, in a half dozen years more. But whether we do or not, the submarine has come to stay: and her capabilities within her narrow field of work are to-day better known from the results of trials than are those of surface torpedo-boats, or for that matter, of battleships, from the results of their trials.

Lieut. E. W. Eberle, U. S. N.—The efficiency of our torpedo service would be decidedly advanced by the adoption of many of the principles advocated by Lieut. Jackson and Lieut. Chandler in their valuable papers on torpedoes and torpedo craft. A definite "building policy" for torpedo craft should be adopted and strictly followed. I believe we should have three classes of torpedo vessels, as follows:

1. Destroyers of 500 tons displacement and 28 knots speed.
2. Coasting torpedo-boats of 200 tons displacement and 26 knots speed.
3. Harbor defenders of 100 tons displacement and 23 knots speed.

I am opposed to sacrificing strength and sea-worthiness in destroyers for the purpose of obtaining phenomenal speed. In order to gain a few more knots in speed, the frames, plates, and machinery of torpedo vessels are shaved down to the very limit of safety. The vessels are lacking in stiffness, and their excessive vibration at high speed, in moderate weather, soon disables the lightly-built engines. I would much prefer a 28-knot destroyer with strong frames and comparatively thick plates and with good sea-going qualities, to a 32-knot vessel with its light frames and "egg-shell" plates, and consequently with a sea-worthiness so questionable as to make it a source of constant anxiety to the commander-in-chief and to its own commanding officer, even in moderate seas.

The *lightly-built* destroyer with its *phenomenal speed* is out of place in a cruising fleet, while the strongly-built vessel with its good sea-going qualities and its *reliable speed* should be able to cruise with the fleet and take care of itself in all kinds of weather.

I hope to see an early adoption of the principle, "Torpedoes in torpedo vessels and in nothing else"; and I hope to see large, stout, well-armed destroyers, with strongly-built engines and with ample coal and water supply—destroyers capable of *developing and maintaining a sea-speed of 28 knots whenever called upon.* Such vessels would not hamper the movements of the fleet, and instead of being a source of weakness and annoyance, they would prove a most valuable adjunct. On a displacement of 500 tons we should be able to build a staunch and speedy destroyer. To my way of reasoning, it is far preferable to have with the fleet a class of strongly-built destroyers which will respond with a steady speed of 27 or 28 knots whenever called upon, than to have a lightly-built class with a reputed speed of 32 knots under favorable conditions of wind and

sea, whose speed is more a matter of record than of fact, and whose toy-like engines are liable to "refuse duty" at most inopportune times.

I will reaffirm here what I advocated several years ago in a discussion on the subject, that in my opinion the appropriation for each battleship or armored cruiser should contain a provision for *two destroyers*. These destroyers should attend the battleship during all manœuvres; and in time of hostilities they should serve as her faithful "watch-dogs" at night, always on the alert for torpedo-boats and rams. The service these destroyers could render a fleet would prove most valuable—some on the scout and others on the lookout; and they would form the inner picket line for the fleet, the outer line being formed by the large cruising scouts. How much more secure and comfortable the fighting ships would feel when on the blockade or when approaching the enemy's coast, if each one had two efficient destroyers to insure protection against night attacks of torpedo craft. The destroyers should be a "part and parcel" of their *parent-ship* and should look to her for everything.

The coasting torpedo-boats should have an *actual speed* of 26 knots, and should be strong enough in structure to be able to accompany the *sea-going* fleet during moderate weather in cruises along the coast and at all times to accompany the *coast-defense* fleet.

The "harbor-defender" class should be lightly built and able to maintain 23 knots for at least one hour; and their duty should be to make night attacks from blockaded harbors. Their cruising should be confined to inland waters, and they should traverse the canals in going from port to port. These small vessels should be attached to the *harbor defense* monitors and rams.

In general, the destroyers belong to the sea-going fleet; the *coasting class* to the coast-defense fleet; and the harbor-defender class to the harbor-defense fleet.

Torpedo vessels of the destroyer and coasting classes should be kept in commission with full crews, but the harbor defenders should be laid up with reduced crews during the winter months.

These vessels would constitute a most excellent training service for officers and men.

No officer above the grade of lieutenant should be assigned to command a torpedo-vessel, and no officer or man should be kept in a torpedo vessel longer than two years. This training on torpedo craft would give to the naval service a set of sharp-witted young officers, self-reliant and quick at meeting emergencies; a class of bright young seamen alert in their duties, who would make good material for future petty-officers; and a well-trained and efficient engineer force with a thorough knowledge of handling and caring for delicate machinery.

Torpedo vessels in the hands of any but the most efficient personnel are next to useless; and an efficient personnel can be obtained only by long, hard experience of torpedo craft. There is no calling in the professional or commercial world which exacts such thorough knowledge, self-reliance, and constant care, as must be exacted of the officers and men of torpedo vessels, if they are to render efficient service. Men who

have been trained in torpedo-boats will readily adapt themselves to the various duties on cruisers or battleships, and at the same time they will constitute an intelligent reserve force for manning or filling vacancies in torpedo vessels.

Naval Constructor WILLIAM J. BAXTER, U. S. N.—The Institute is to be greatly congratulated upon receiving this paper (Torpedo-Boats: Types and Employment), as it is of that type which adds great value to the Institute's proceedings. It not only shows the results of much laborious study and painstaking compilation of details, but also shows an unusual amount of careful observation during practical service experience, together with well-considered suggestions for improvements which personal experience suggested as desirable or necessary.

It is, of course, well known that a ship will compromise in her design; it may not be so well known that recommendations concerning the improvement of any completed vessel which has seen active service are so numerous and so contradictory that the element of compromise is still exceedingly strong. And while I concur with many of the author's suggestions, and while I consider many others of them of extreme value, it is but proper to state that there are still other of his suggestions which should not be adopted. This is said, not in a critical or disparative sense, but merely as the expression of personal opinion. No doubt, a large majority of the readers of this valuable article have the same opinion as regards their agreement or variance with the author's views, and it is extremely doubtful if any two readers would agree entirely in their opinions. These varying opinions, however, really increase the value and weight of the paper, because the author has stated his own opinions in a clear and positive manner after much thought; whereas those mere verbal commentaries, which are not infrequent in our own and other services, are not entitled to much weight.

The Navy Department's policy, of the new torpedo-boats of different sizes, by different builders, and of different designs, is well shown by this article, because if they had all been built of the same size and upon the same design there would have been no opportunity for this instructive article, and it should be remembered that for similar reasons it is not necessary that any one particular design, no matter how perfect it may appear to be under any one set of conditions, should be repeated indefinitely. This applies not only to the design of the vessel itself, but to every detail of her construction. It has been the common experience of myself, and no doubt that of many others, that even in regard to the most minor details of sister ships, an article which was entirely satisfactory to one officer or one petty officer, is entirely unsatisfactory to others, and it is only by hearing the opinions of a large number of officers and weighing their experience and judgment that final and absolute improvement can be made by those of us who build and fit out the ships.

It has been my endeavor for a number of years to urge and carry out simplicity in all the details of warship construction, and it is a pleasure to see the strong argument for simplicity in torpedo-boat construction

brought forward by the author, as it has been my ordinary experience to find that the officers of ships in commission always want something more added, thus increasing the complication, while it is extremely rare to find an officer to speak seriously of having something removed without having something else put in its place.

The author deserves the thanks of the entire Institute for his very valuable paper.

Naval Constructor T. F. Ruhm, U. S. N.—In order to satisfy the desire for great speed in torpedo-boats and torpedo-boat destroyers, the weights of machinery and hull must be reduced to a minimum, thus increasing the possibility of serious accident to both. The extreme lightness of the scantlings of the hull increases the effect of the tendency of all parts to vibrate, and such extreme vibration must undoubtedly affect not only the strength of the material but the nervous systems of those on board. The reducing of the speed requirement by two knots and the increasing of the weights of hull and machinery accordingly would give a really more efficient vessel, less liable to accident, and more capable of standing whatever weather may be encountered, or whatever handling around docks, etc., may be necessary in the course of the general duties of the vessel.

In the case of the trial trip of one of the fast destroyers the vibration of the stern plating was such that a piece of one of the plates in the neighborhood of the propeller by constant buckling finally broke and a three-cornered piece was torn out by the rush of the water, the stern compartment rapidly filling. On the same vessel, in trying to get away from the dock, the stem was gently touched against the adjacent wharf, the result being that the stem was absolutely twisted out of shape and part of it required replacing. Were the scantlings of this boat consistent with the duty required, accidents of this sort would have no serious results.

While the fitting of small ventilators which are always open may be undesirable on account of the possibility of salt water and rain entering through such ventilators, it would seem that arrangements should be provided for ventilation under favorable conditions, provision to be made to readily close such openings when necessary. The fitting of some arrangement of this sort in each principal living space or cabin, so arranged as to be readily closed from beneath, should give satisfactory results. A type of bent cowl with a scuttle at deck opening which can be closed so as to be absolutely water-tight, or partly closed so as to leave a small opening, should be satisfactory, and the location thereof could be so arranged as not to interfere with the gangway on deck.

The fitting of air-ports on the sides of the vessel is very necessary within certain limits, but should not be carried to too great an extent on account of danger due to the extreme height of the bow and stern ways and the squat of the vessel.

The ventilation cowls should be fitted with clamps or screws so that the cowl can be trimmed in whatever direction may be desired, and clamped in place so that it will not turn.

What appears to be a satisfactory manner of lining the living spaces is to fit furring battens against the skin of the ship and on such battens tack asbestos or canvas, well covered with paint.

The having of the closets and bathrooms adjacent to the galley is open to a good deal of criticism, although such arrangement is almost unavoidable. These compartments should be adjacent to the crew's space and each have a door opening into the crew's space, while there should be no means of communication between the galley and closets; the bulkhead separating such spaces to be a double bulkhead with air space between.

An apparently satisfactory arrangement of life rail and stanchions is to omit the low life-rail stanchions formerly fitted, and in lieu thereof provide stanchions at intervals of about twelve to fifteen feet of a height sufficient to take the awning spreaders; and extending between these stanchions five light phosphor-bronze wire ropes, the upper one reaching to about the height of a man's shoulder, and through the tops of the stanchions the awning-ridge rope. These ropes fitted with turnbuckles and so arranged as to allow of proper openings abreast gangways, boats, etc., should give very satisfactory results.

Large drinking-water tanks should as a general thing be made of galvanized iron, and be fitted with manholes large enough to allow access for cleaning. The most natural place for such tanks would be under the galleys. This arrangement I believe is now that generally adopted.

There is in my opinion a very large amount of valuable information contained in this excellent paper.

Naval Constructor T. F. Ruhm, U. S. N.—Referring to the paper by Lieutenant Koester on "The Torpedo-Boat, Destroyer, and Depot," there appear on page 853 certain suggestions in connection with which I would submit the following:

The feed-water supply of torpedo-boats can be materially increased by fitting the forward compartment, corresponding to the trimming tank on large vessels, for carrying fresh water, the necessary piping to the feed pumps being fitted. This water can be considered either as part of the main feed-water supply, or as a reserve supply, as circumstances might decide.

The handling of the anchor on a torpedo-boat by the crew without any anchor engine would in my opinion be rather unsatisfactory owing to the arrangement of the turtleback now generally conceded to be most desirable. A small electric winch fitted adjacent to the locker in which the anchor cable is stowed would be comparatively light, would not involve the heating of living spaces by steam pipes, and would occupy space which by virtue of its position in the ship and limited extent, would be easily available for the purpose. Of course such engine would necessitate the existence of a dynamo on board, but this is in my opinion highly desirable.

I question the efficiency of omitting deck covering and supplying the crew with rubber-soled shoes, and think that some deck covering is ab-

solutely necessary, preferably a very light linoleum, the body of the strips to be cemented to the deck, and edges and ends secured by very thin brass strips bolted with light bolts through the deck.

The securing of the deck cover over the boilers with bolts so that it may be easily removed for hoisting out boilers would be a very good scheme if practicable, but I do not believe with such light material the bolting together of these parts could be done so as to give satisfactory results as regards water-tightness and rigidity, especially when attempting to fit the pieces together again after having once taken them apart.

The making alike in every respect of all destroyers and of all torpedo-boats is in my opinion most desirable, and should be carried out even to the smallest details; standard designs should be adopted for water-tight doors, hatch fittings, life rails, eye bolts, etc., and the internal arrangements, locations of batteries, tubes, boats, anchors, etc., should be made identical for all destroyers, and for all torpedo-boats.

Lieut. L. H. CHANDLER, U. S. N.—1. In studying Lieut. Jackson's article, I am much pleased to find that in almost all important matters there is a similarity in our opinions. I am very glad to find my views in regard to torpedo matters are in the main upheld by the very able prize essayist of this year.

2. In his "Detailed Criticism and Comparison of Certain Points in Construction," Lieut. Jackson has given many facts which would lead to his being held in grateful recollection by torpedo-boat officers and men, could he succeed in getting his schemes carried out by those who build the boats. A careful study of his remarks on this subject by those who design, build and fit out boats would result in many blessings to personnel.

3. To speak in detail as to one or two points under this head, I may say that the canvas lining of living spaces should be so arranged, open in proper places at top and bottom, that a through circulation from the deck up to the hatches would be ensured, thus sending the heated air up and out instead of confining it between the lining and hull. The deck overhead should have this inside lining also.

4. I believe that the only way to satisfactorily arrange sink and wash-stand drains, etc., is to have them discharge into buckets, to be emptied by hand. The automatic valves on board the Mackenzie were most annoying in their inefficiency, and I do not believe they could be made successful on board any torpedo vessel.

5. As Mr. Jackson says, the officers' quarters should undoubtedly be forward. There are so few officers on board these boats that it is essential that the voice should be able to carry from the officers' quarters to the helm and vice versa. This would mean the greatest relief to the officers when under way.

6. Referring to the steering-gear of the Mackenzie, I may say that (as I understand it also the case on board some other boats) the rudder is so much overbalanced that when the helm is hard over it is much harder to get it started from that position than it was to get it there in the first place. This fault renders her rather hard to handle in tight places, and

an attempt to suddenly steady her when the helm is hard over results in manœuvres calculated to cause astonishment on the part of spectators. This would not have been so important had she been fitted with steam steering-gear, but even then the fault is one which should be avoided.

7. Referring in general terms to a comparison between Mr. Jackson's essay and my own, I believe that the two intermingle very well, that each of us has covered fully some points that the other touched upon but lightly, and that, when taken together, they form a very complete and, in the main, harmonious treatise on torpedo-boat tactics and warfare as adapted to the use of our service.

8. The one essential point on which Mr. Jackson and I differ is as to the classes of vessels we should use. Mr. Jackson favors:

(*a*) Torpedo-boat destroyers. Boats of about 400 tons, and 28 knots speed.

(*b*) Sea-going torpedo-boats (picked). To be able to keep the sea for more than a week. About the size of the Porter.

(*c*) Torpedo-boats (stationary). Talbot class.

Personally I favor:

(*a*) Torpedo-boat destroyers of the type we are now building.

(*b*) Sea-going torpedo-boats between the Porter and Morris types, say about 150 tons, 150 feet in length, 15 feet beam, 4 feet mean draft.

(*c*) Ships' torpedo-boats.

9. It will be seen that we agree as to *a*. Personally I do not believe in the Talbot type, while Mr. Jackson does. This may result from his having been more familiar with the Herreshoff-built boats of the type while my experience was with the others. I believe that the Gwin and Talbot could make 20 knots easily at any time in smooth water, but they have only one boiler apiece, and tubes will give out at odd moments, which means a totally disabled boat with that type. The Mackenzie and McKee cannot make 20 knots in service, in fact the Mackenzie had great difficulty in making it on her trial trip, and the McKee did not succeed. I cannot believe these boats to be efficient, even for harbor work solely, and I do not believe that the difference in draft and visibility between them and my proposed *b* type is sufficient to make up for the superior speed and seaworthiness of the bigger class. So I would have the station boat and the sea-going torpedo-boat combined in one class as given above in *b* of my classification.

10. Mr. Jackson does not touch upon the value of torpedo launches as part of the outfit of large ships, while I believe there is a distinct field for these craft.

11. As to battery, I would arm the types of boat I suggest as follows:

(*a*) Destroyers: Two 5-metre torpedo tubes on the midship fore and aft lines for fire on either side. Two 4-pdr. R. F. guns on the middle fore and aft line, one forward and the other aft. Six 6-pdr. semi-automatic guns, three on each side, one pair with ahead and another with astern fire.

(*b*) Torpedo-boats: Two 5-metre torpedo tubes on the midship fore and aft line for fire on either side. Four 3-pdr. semi-automatic guns, two on each side, one pair with ahead and another with astern fire.

(*c*) Ships' torpedo-boats: One 3.55-metre tube on midship fore and aft line for fire on either side. One 1-pdr. automatic gun.

12. I may say in this connection that spare torpedoes are very good things to have, but nothing else should be given up for them. I agree with Mr. Jackson in this particular, and think that such spare torpedoes should be carried aboard larger ships, either warships or torpedo-depot ships, or retained at the shore base from which the boats are operating.

13. As rapidly as it may be done without undue expense, I would relegate the 3.55-metre torpedo to obscurity, except for ships' boats. I would rather have a boat with two 5-metre torpedoes than one with three 3.55-metre ones. This gives me an additional argument in favor of my type of torpedo-boat. The Morris, which is somewhat smaller than my *b* type, carries three 5-metre torpedo tubes, the Talbot, Gwin, McKee, Mackenzie class are too small to carry more than one long tube and hardly that.

14. Except for the one essential point herein set forth, I have no criticism worthy of note to make upon the prize essay, except to most heartily commend in general the views of my brother officer.

"Torpedo Craft: Types and Employment."

Naval Constructor Lloyd Bankson, U. S. N.—This paper being of such a practical nature, in which the defects and good qualities of torpedo-boats in general are described by an officer whose experience and interest in them render the paper of great value to all those who are interested in the design or ultimate command of these little vessels, I would like to run over briefly a few of the points which interest me particularly as a constructor.

In regard to the number of torpedo-boats it would be advisable to build, I can corroborate the sentiment on page 13, that "these boats would give a certain feeling of protection to the people and liberate more valuable and powerful vessels for offensive operations."

From my experience ashore, in a peaceful community during the late Spanish war, the alarm and consequent efforts to obtain what was considered necessary protection (had the Spanish ships appeared at all off our coast) would have paralyzed the movements of naval vessels, while a single torpedo-boat would, in my opinion, have quieted the unnecessary and unreasoning alarm of the people concerned.

Apparently, from the criticisms and comparisons in this paper in regard to the details of construction of torpedo-boats in this country, the principal item is the question of ventilation.

I do not think that the writer of the paper will find that all those who have had experience with torpedo-boats will agree with him in regard to doing away with fixed ventilators, which is practically what he advocates.

What is taken as a striking example of a ventilator over a cabin, does not seem to be as serious as one might be led to suppose. The fact that this ventilator was probably provided at the bottom, on the inside, with a plate to make it tight in bad weather, shows that the disagreeable

features mentioned were anticipated, and, by closing the bottom by the plate provided and putting a canvas hood over the outside, the ventilator was practically done away with and no harm resulted. In hot weather, in smooth water, whether under way or in port, it would seem that this ventilator would have been quite convenient and even necessary.

The suggestion of using hoods over the hatches is a good one, and they have been fitted in the petty officers' quarters on the Dahlgren and T. A. M. Craven. The officers' quarters being ventilated by small screw-down ventilators, a skylight and the after conning tower.

In this connection, I think these small ventilators of the Dahlgren and T. A. M. Craven, while possibly not acting as thoroughly as ventilating hoods, should certainly have no disadvantages in the shape of leaking in bad weather, as they can be hermetically closed.

In reference to the subject of clear decks, I quite agree that they should be as free as possible from obstructions of all kinds, but on torpedo-boats this is a very difficult matter, particularly as even the writer of the paper suggests numerous chests for ice, deck gear, tools, etc., so that at best the decks are bound to be pretty well taken up with different articles, whether they are projecting hatches, ventilators or what not.

In regard to deck covering, it might be better, I think, to go back to the ordinary gratings fitted originally on the Cushing, doing away with linoleum, battens, etc., altogether. The fastening of these gratings with cleats will keep them in place in ordinary weather, and I think, as the writer suggests, they would be valuable in making a raft in case it was necessary to abandon the boat in a hurry.

The writer's suggestions in regard to covering platforms in living spaces have been carried out on the Dahlgren and T. A. M. Craven, and present a very neat appearance, and I trust they will be satisfactory in service.

These two torpedo-boats are ceiled throughout in the living quarters with canvas, both overhead and sides, and it is believed that they will be quite satisfactory, and, if a proper steam-heating arrangement is installed, they should be as comfortable as a torpedo-boat can be made.

The two tiers of bunks, with pipe frame, and loose canvas bottom, I believe are very satisfactory, and I think I can claim credit at least for introducing the laced canvas bottom on the Ericsson. It certainly is light and can be easily kept clean.

On the Dahlgren and T. A. M. Craven the galley is on deck, which is, I believe, a capital arrangement.

I think a fixed bath-tub in a torpedo-boat is rather out of place, on account of the large amount of fresh water required (if fresh water is used) and the valuable space it takes up. The ordinary portable tin tub should be quite satisfactory.

The wooden guard mentioned has been fitted on the Dahlgren and T. A. M. Craven, and is, I believe, an excellent idea.

I have always advocated the cork annular life buoys on torpedo-boats, and believe they should be stopped around the rail, from one end of the boat to the other, on both sides.

A port fire attachment could be very readily fitted to a few of them.

I have always been of the opinion, and still consider (and I believe I am not alone in this regard) that steam steering engines and steam windlasses are unnecessary on a torpedo-boat, although of course they may be of use on destroyers. By having hand steering-gear and hand power for getting up the anchors, the steam pipes in the living quarters forward are done away with altogether, thus obviating one objectionable source of heat.

In regard to the criticisms on ordnance made by the writer of this paper, I do not quite agree with him that our torpedo-boats are under-armed with guns, on account of the strain to the light structure of a torpedo-boat from the recoil of the larger guns, which will ultimately injure the decks to an appreciable extent, in my opinion.

I have dwelt particularly in my statements on the Dahlgren and T. A. M. Craven. These boats represent, I believe, the latest practice in France and contain a great many of the good points required by the author of this paper, and I believe that a disinterested person, capable of judging the good qualities of a torpedo-boat, will find much to admire and but little to criticise in these two boats.

I think there are two slight errors in this paper:

One, on page 8, 4th line; I believe that the 23-knot torpedo-boats referred to had single screws instead of twin screws.

Again, on page 17, 12th line from the top; I think "30 knots" should read "29 knots."

"Torpedo Craft: Types and Employment."

Naval Constructor R. M. Watt, U. S. N.—Of all literature on the torpedo-boat and torpedo-boat design, I consider this paper to be the most practical one, and therefore the most valuable. It should be placed in the hands of every torpedo-boat builder and every government inspector, and I believe will assist them greatly when dealing with details of design. On the first eleven torpedo-boats it has been found necessary to remedy many of the defects noted by Lieutenant Jackson.

Relative to types of torpedo craft, I can see no advantage whatever in multiplicity, believing that one type of destroyer and one type of boat will most efficiently answer the requirements of service. The destroyer should be of sufficient speed and armament to destroy a torpedo-boat, or to disable a destroyer, which can be accomplished on about 400 tons displacement. The torpedo-boat should be of the smallest size consistent with *emergency* sea-keeping power, which requirement the Morris appears to satisfy. There is no duty outlined for the sea-keeping torpedo-boat which the destroyer could not more rapidly and more efficiently perform. I can see no justification for the existence of a small, limited capacity station boat of Class R. With a navy suitable to the requirements of the country under the orders of an efficient commander-in-chief, no enemy's fleet is likely to get within the range of operation of the small station boat; and in case an enemy's vessels did force an entry into a harbor, or waterway, the attack should be made by the torpedo-boat proper because of the increased chances of success.

Referring to the detailed criticism, there are points untouched, upon which the views of the sea-going officer, the user of the boat, would be of interest to the designer and builder of the boat.

Does the turtleback type of boat so consistenly followed abroad and adopted on the Cushing, Ericsson, Foote class, etc., make a better sea boat than the flat deck carried to the side, as in the Herreshoff-built boats?

Is the main drain, with which practically all torpedo-boats are fitted, ever used? In practically every case I have investigated, I have found it in an unserviceable condition. Piercing the transverse bulkheads below the water-line, it appears to be a source of danger rather than of value. In case a compartment is flooded, it would be advisable to leave the water alone until the leak was stopped, when the water could be readily handled by a handy billy pump and by the steam siphon with which every compartment is fitted.

I regret that Lieutenant Jackson has not discussed the location of the steering leads, also of the torpedo tubes. Present practice in this country is to carry the steering leads under the deck, which means passing either through a coal bunker or over the boilers, thereby rendering the leads from the forward conning tower inaccessible when the bunker is full, or when steam is on the boilers. Because of their inaccessibility, they are less frequently inspected, and poor condition is very apt to be made known only by a breakdown when repairs are impossible, and a shift to hand-gear in the after conning tower then becomes necessary. I have in mind several instances when a torpedo-boat came into New York Navy Yard with a steering lead carried away, and it was necessary to wait until the next day to permit the boilers to cool off before examination could be made. Further below decks the leads are far more liable to jamming by a splintered or bulged plate. In this connection I call attention to the leads on the Somers, which are placed on the round of the turtleback just outside the line of stanchions, where they are always accessible, and under practically all conditions, emergency repairs can readily be made.

As regards the torpedo tubes: It has in general been considered necessary to place one of the tubes on the center line well aft. This tube will be required for discharge direct astern only when fleeing at the highest speed from a more powerful pursuer. Will not the much-disturbed water astern into which the torpedo is discharged have such a deflective effect upon it as to make its discharge valueless? Would it not be better to locate the tube some distance from the stern when a slight sheer of the helm would permit of discharging the torpedo into water free from the screw disturbance and certainly increase the chances of its reaching its destination?

A word as regards torpedo-boat fittings in general: In torpedo-boat construction, the constant endeavor of the builder has been to economize weight everywhere, in order to secure high speed on the trial trip, until the weight put into certain fittings has been so much economized (reduced) that the fittings have been rendered unserviceable. This question of weight of fittings is not one of vital importance; it is in fact of little

importance except as regards builders' trial-trip speed. Should a torpedo attack be contemplated, the vessel would probably be stripped of all fittings: boat davits, torpedo davits, awning and life-line stanchions, life lines, awning spreaders, awnings, deck gear, and all readily removable gear below decks except such as contributed to fighting efficiency. There is therefore no reason why durability and efficiency should not be insisted upon for all of the above fittings, and particularly *demanded* for those upon which the safety of life while cruising at sea depends.

One direction in which this economy in weight has been carried to excess with disastrous results is in the case of life-line stanchions and life lines. When going into action the arrangement of life lines will probably be entirely different from the ordinary cruising arrangement. It has been suggested that one or two stout lines be run fore and aft along the center line of the vessel; perhaps one breast high for fore and aft passage, and one on the deck level with numerous trailers in the water to which it is hoped any one falling would cling.

Profiting by a knowledge of the unsuitable and unsatisfactory fittings which had failed in service, the following general arrangement of life-line fittings has been prepared at New York Navy Yard which are believed to be of the least possible weight consistent with rendering life secure while at sea. Awning stanchions carry the life lines as well as the awning spreaders. Life lines are five in number, the upper life line, forty-eight inches high, taking the place of a life line customarily rigged breast high before taking a torpedo-boat to sea. The lower life line is fitted seven inches from the deck, so as to render it impossible for an unconscious or disabled man to be washed overboard between the lower life line and the deck.

Lack of space prevents further discussion of the many details in which there is much room for decided improvements, which improvements I believe will be materially hastened by this paper.

Naval Constructor H. G. Gillmore, U. S. N.—Lieutenant Jackson's valuable contribution to the literature on torpedo craft is entitled to especial consideration on account of its writer's association with torpedo-boat work; and the great care and thought which he has bestowed upon the exposition of the opinions which rest upon the experience so gained.

In criticism of his treatment of the matter of types of torpedo vessels it might be said that its discussion is based, in the first instance, upon unsound propositions. To one, who, regarding the torpedo-boat as a weapon, undertakes serious study of the latest types of torpedo craft, and the course of development by which they have been reached, the conclusion is unavoidable that this development has been influenced by many other considerations than those of the torpedo-boat as a weapon. None of the types leading up to the present ones have ever been systematically and carefully tested, after training crews to the peculiar life required by the special service, to determine their fitness for the designed purpose or the lines along which changes should be made. What, then, is there in "practice abroad" upon which we may rest the determination of types for our own use?

The writer's statement relative to the rôles assigned to torpedo vessels during the Spanish-American war are so much to the point that it is surprising that their experience should be advanced as a ground-work for anything, excepting possibly a discussion as to seaworthiness and sea-keeping qualities. It is under his third head only that there is introduced a reasonable point from which to begin a discussion upon types of torpedo craft.

The object for which torpedo vessels are constructed is the destruction of vessels of the enemy. It is intended that a vessel costing a few thousands of dollars and manned by a handful of men shall attempt the destruction of vessels costing hundreds of thousands of dollars, carrying hundreds of men. This is the prime object and mission of the torpedo-boat. One division of this special class may be called upon to attack torpedo-boats in order to protect the vessels of the fleet from injury by them.

The condition of equalization which comes in to give the immeasurably weaker unit a chance of success against the cruising ship is the secrecy of action possible under cover of darkness or fog. It is because this equalizing condition makes it possible that, at the risk of a few lives and the product of a few months of toil, the destruction of a vessel requiring many months to construct, costing hundreds of thousands of dollars and involving hundreds of lives, may be effected, that nations are willing to expend the money for, and individuals will risk their lives in attacks in, the torpedo craft. For the secrecy of action and immunity from discovery upon which success is contingent, the torpedo-boat depends upon the visible surface which she presents—that is, upon her size. It is her small size which enables her to creep upon her antagonist and deal the deciding blow. Early discovery means failure to her always, and probable destruction. The protection of the torpedo vessel lies primarily in her size. In her secondary rôle of protector of the fleet against torpedo-boat attack, she is also dependent upon her size for success. To destroy, she must discover, and to discover the torpedo-boats making a stealthy approach it is necessary that the size and visible surface of the guarding boat should not be so greatly superior to that of the attacking boats that they may make her out in time to avoid her. The modern torpedo-boat destroyer, by its large size and attendant visibility, will, under the circumstances which are admitted as possible for torpedo-boat attack, defeat its own purpose. For success in any rôle within its province, it is imperative that the torpedo-boat should be of the smallest size consistent with the other necessary conditions. The advantages in number of men involved in each action, in first cost, and in handiness which accompany small size are so obvious that they need be only mentioned.

This brings up the question of classification. The writer, taking a small section of a general classification of all vessels of war employed in the English Naval Pocket Manual; in which the letters of the alphabet are employed consecutively; substitutes displacement for length and discovers that chance has made possible the use of the words "picked" and "questionable" where they were never contemplated in the original classification. The system of classification proposed is, even when applied only

for purposes of comparison of torpedo craft, already built, an extremely loose and inaccurate one. Its use to designate types which it is proposed to fix upon or introduce is indefensible. There is probably nothing about foreign torpedo vessels, of which so little is accurately known as their displacement.

The purposes for which torpedo craft are required naturally divide them into two classes—the sea-going and the harbor or coast defense or, as they are designated in this paper, the station. The so-called torpedo-boat destroyer is only the last term in a series of progressions dictated by many considerations quite foreign to the real purpose of the vessels; but not the less a sea-going torpedo-boat for all that.

This natural division must be recognized; and then a logical consideration of the question, having in view all the requirements in both classes, and giving the fullest weight to all available experience as to seaworthiness and sea-keeping and offensive qualities, would, it is believed, lead to, for the sea-going torpedo vessel, a considerably smaller craft than the present, so-called, destroyers; and for what the writer designates as a " Station Boat," something similar to the small boats proposed by him.

Ventilators. The writer's experience would seem to be directly opposed to that of officers of the British service; for all torpedo-vessels, building for the Admiralty, are fitted with a great number of portable small ventilators, the tendency having been in the direction of increase rather than decrease in number. Sugg's patent ventilators are used; for the compartments under the turtleback, forward and elsewhere, cowl tops of the usual type standing about four feet above the deck. His proposition seems to be to fit hatches with a form of cowl or other ventilating top and omit all other ventilators, so necessitating at least two large openings in even the smaller compartments. It is believed that this would lead to a very much more cut-up deck space and less satisfactory results as to dryness and ventilation in really bad weather.

Clear Decks. The suggestions with reference to this important matter would be most welcome to the builders were they not nullified by the suggestions as to access to and ventilation of compartments, as will be recognized at once should the latter be applied to, say the Morris.

Deck Covering. The effect of the splintering of deck gratings in action should be considered in fixing upon a material for deck covering. If current practice abroad may be taken to represent the teaching of experience, linoleum seems to have stood the test of time.

There can be little question as to the desirability of canvas or other ceiling in quarters of boats upon which the crew are required to live.

Officers' Quarters. The great difficulty in satisfactorily arranging these lies in the great diversity of opinion among those who have to occupy them. When the architect has turned out a type of dwelling, the plans for which every family, with let us say an income of $1000 a year, would accept without suggesting modifications, perhaps naval architects may hope to be equally successful in their efforts to arrange quarters so that every officer who comes to occupy them in the course of the life of the ship will be fully satisfied with them.

The writer's comments upon "Deck Fittings and Equipment," especially as to the utility of metal boats and the failure of folding boats, are deserving of notice.

Whatever the type of steering engine employed, the only reasonable position for it on board a torpedo vessel is the engine-room, where it may have the same care and attention as the auxiliaries of the propelling engines, and its continued use does not result in the heating of living spaces.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE NAVY'S COOPERATION IN THE ZAPOTE RIVER CAMPAIGN.

By LIEUTENANT EDWARD W. EBERLE, U. S. Navy.

June 1, 1899, found the Southern Division of the Insurgent Army in complete control of Cavite Province, with the exception of the small peninsula on which the Cavite Naval Station and the town of San Roque are situated. The northern boundary of the Province of Cavite is marked by the treacherous Zapote River.

Insurgent outposts were located several miles beyond this river, and a considerable force occupied the villages of Las Piñas and Parañaque.

Parañaque—the place where our troops first landed the year before for the attack on Manila—is a small fishing village on the south bank of a narrow inlet of Manila Bay, frequently called Parañaque River, and is only five miles from Malate, which forms the southern section of the city of Manila. Here the Insurgents built strong entrenchments, as they could not approach nearer to Manila without encountering the First Division of our army, which occupied trenches on the opposite side of the Parañaque River.

The U. S. S. Monadnock lay at anchor among the fish-weirs off Parañaque, within easy range of the Insurgent trenches and the bridge spanning the river. She had held this position for two long months—and they were, indeed, long, weary months of constant watching; because being within Mauser range of the shore, she was exchanging shots with the enemy almost daily, while at night her search-lights and patrol boats were detecting *cascoes* and *bancas* in their attempts to run the blockade with all

kinds of supplies. Upon one occasion a casco load of horses was captured—evidently prospective mounts for "Insurgent generals."

Few people have fully appreciated the trying work of the Monadnock as she lay there supporting the right flank of our entrenched soldiers and stopping all traffic with the enemy. Being under fire at all hours of the day and night, it was necessary for her officers and men to remain behind the protection of her turrets or below decks; and, as she was cleared for action, the heat was almost unendurable. But, when the commander-in-chief offered to relieve the Monadnock from this arduous duty, her captain, Henry E. Nichols, begged permission to hold his station. He did not live to see Parañaque occupied, as on June 10, after his ship had shelled the Insurgents out of the town and our troops could be seen coming over the hills, he died suddenly of heat-stroke, thus giving up his life for the country he had so faithfully and honorably served.

The Monterey, like the Monadnock, was kept busy day and night. She was anchored in Bacoor Bay and had the Naval Station under her protection, while her launches patrolled the beach to enforce the blockade.

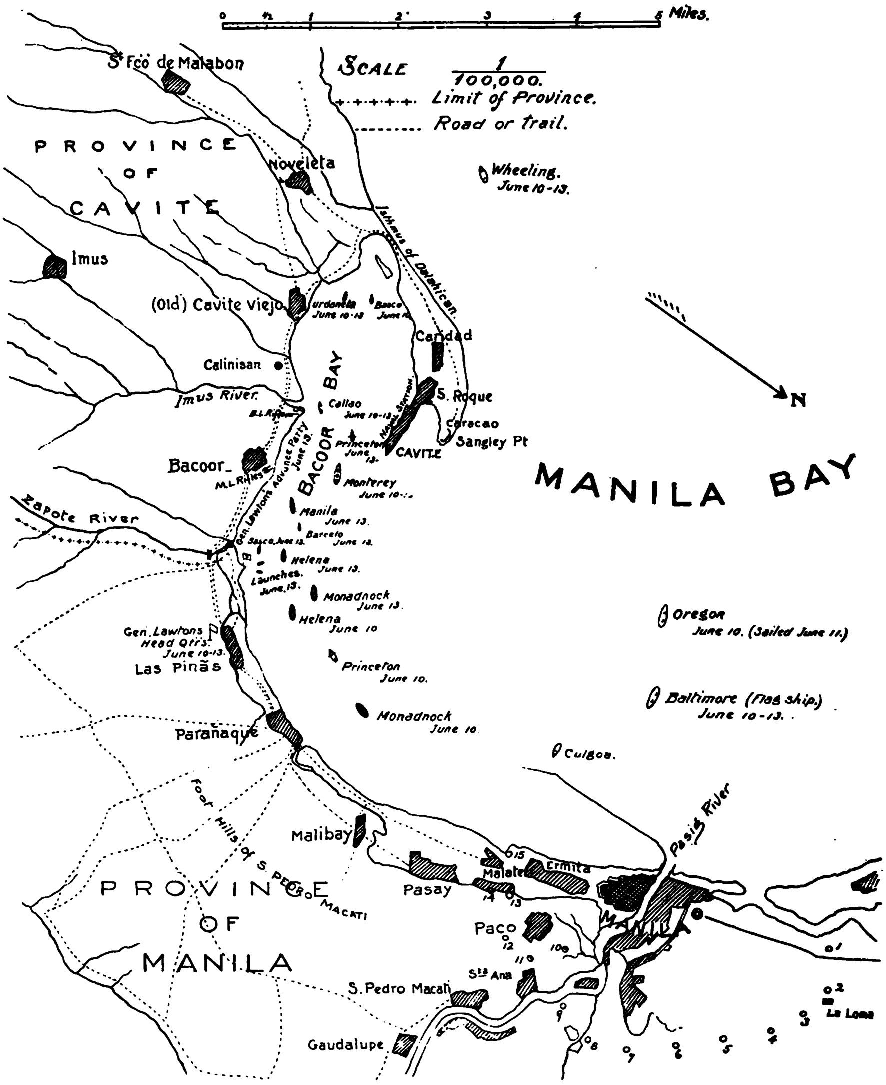
The gunboats Manila and Callao—formerly Spanish vessels—cruised during daylight; and at night anchored in positions to control the narrow Isthmus of Dalahican, which joins the Naval Station to the mainland, and which was held by a battalion of our troops. The Insurgents occupied trenches a short distance beyond the isthmus or neck, and held the towns of Cavite, Viejo, Bacoor, and Noveleta, opposite the Naval Station.

The town of Imus, on the Imus River, was the capital of Cavite Province, and was also the military headquarters of Gen. Baldamero Aguinaldo—brother of Don Emilio Aguinaldo—who at this time was in command of all the Insurgent forces in the province, and with whom Gen. Mariana Trias, a prominent Insurgent leader, was supposed to be associated.

The country between Parañaque and the Imus River is low and marshy, being cut up by many streams and small rivers. The undergrowth is very dense, and the only clearings are rice marshes and mangrove swamps. The main road leads along the shore-line of the bay, and at places is only a few yards from the water. The nature of the country compelled the travel to

PLAN OF CAVITE AND MANILA PROVINCES

COVERING OPERATIONS FROM JUNE 10-13, 1899.



be by this road, and as the bridges were near the mouths of the rivers and the road near the beach, the light-draft gunboats could render valuable assistance by clearing the way for an advancing army and harassing the retreating enemy.

For some time it had been the earnest desire of the commander-in-chief of our naval forces to see the country between Parañaque and Cavite cleared of the Insurgents; but the major-general commanding in the Philippines did not feel that he could spare enough men from the northern wing of the army to undertake a campaign in Cavite Province. To the officers and men of the fleet, it did not appear encouraging to see the Monadnock engaging the enemy almost every day, just outside of Manila, and no move made to occupy Parañaque by our land forces. However, all things come to those who wait. On June 9, the commander-in-chief, Captain Albert S. Barker, U. S. N., signaled for all commanding officers to repair on board the flagship, and the welcome news was soon made known that General Lawton was to move on Parañaque and then into Cavite Province with the cooperation of the fleet. This was, indeed, most gratifying news to every one in the fleet from the commander-in-chief down to the youngest apprentice-boy.

Owing to shallow water, the heavy ships could not approach within effective range of the Insurgent trenches, and therefore the Oregon, Capt. G. F. F. Wilde, and the Baltimore, Capt. J. M. Forsyth, were prevented from joining the navy's inshore firing-line. [See chart.] The Monadnock, Capt. H. E. Nichols, was to shell Parañaque and cover the advance of our troops. The Princeton, Comdr. C. H. West, was to take position between Parañaque and Las Piñas and use shrapnel on the retreating enemy. The Helena, Comdr. W. T. Swinburne, was to control the bridge at the mouth of the Zapote River and the road to Bacoor. The Monterey, Comdr. E. H. C. Leutze, was to look after Bacoor and its approaches, and protect the Naval Station. The Callao, Lieut. Benj. Tappan, was to take position at the mouth of the Imus River and control the bridge and approaches. The Wheeling, Comdr. W. T. Burwell, was to take station outside the Isthmus of Dalahican and enfilade the enemy's trenches, while the small gunboats Basco, Naval Cadet Dungan, and Urdaneta, Navel Cadet W. C. Wood, were to assist from the shallow waters inside the peninsula. The commander-in-chief gave explicit di-

rections to use the utmost care when firing at retreating Insurgents in order to avoid firing upon women or children.

General Lawton's plan was to start the expedition during the night of June 9. He and General Wheaton were to move in two columns. One column was to proceed up the Pasig River in cascoes to the vicinity of Guadalupe, then strike to the southward along the lake and come in below Parañaque to cut off the enemy's retreat.

The ships of the squadron were ordered to be underway and in position in the early morning of Saturday, June 10, 1899. The Monadnock was to open the engagement by shelling the trenches at Parañaque, and the other ships were to use their shrapnel whenever the Insurgents could be seen, and also clear the beach in advance of our troops. Vessels drawing less than twelve feet could approach within one thousand yards of the beach. The vessels were underway and in position at an early hour, and the Monadnock opened fire on Parañaque. It was soon evident that the Insurgents were retreating by the main road near the beach, as the ships opened fire all along the line. The Wheeling opened on the trenches beyond the isthmus or neck. For a time the firing was very spirited, after which it was at long intervals, when several shots would be fired in quick succession at small squads of Insurgents as they dashed across bridges and open spaces. The Insurgents returned the fire of our ships with volleys from their Mausers. About ten o'clock the volleys of our troops could be heard beyond the foot-hills back of Parañaque, and near noon, from the Monadnock's fighting-top, the advanced firing-line could be seen in the hills. There were few signs of life in Parañaque at the hour of noon, but the Monadnock continued to throw in occasional shell. About this time, the writer went on board the Monadnock, and in a conversation with him, Captain Nichols said (referring to the Insurgents in Parañaque): "We've got them now!" These were probably his last words, as later on he was found in his cabin prostrated from heat, and died without regaining consciousness. For some reason our troops did not enter Parañaque but swung around to the southward, and before nightfall had occupied Las Piñas, where General Lawton established headquarters, and signaled that he would remain there over night.

Reports indicated that many of the enemy had been killed by

the shrapnel fire of our ships, when crossing bridges and open spaces, but in some instances they were shrewd enough to distribute retreating soldiers among the fleeing women and children, trusting that our ships would not endanger the lives of the helpless and non-combatants. Their strategy was very successful, because our ships ceased firing as soon as women and children were discovered in the retreating groups.

The Wheeling had enfiladed the enemy's trenches located beyond the isthmus, and no signs of life were visible up to nightfall. General Lawton decided to rest over Sunday in order to bring forward supplies, and to enable his men to recuperate from the severe heat prostration they had suffered in the previous day's long, forced march, for the day had been as hot as one of those boiling days in May—Manila's hottest month.

Sunday morning saw the commander-in-chief and a party of officers at Sangley Point standing around the newly-made grave of Captain Nichols—the navy's deplorable loss in the preceding day's work—and the oppressive calm of that tropical morning would not have been broken, save for the funeral volleys and last taps that mournfully resounded over placid Bacoor Bay.

The ships had anchored in positions for controlling the shore between Las Piñas and the Imus River, and were given a comparatively quiet day. The Manila arrived from a ten days' cruise on Sunday, and was assigned a position on the inner firing-line. The Oregon sailed for the north on the same day to establish a blockade of Lingayen Gulf.

The army did not move on Monday, and the ships held their positions, with the exception of the Helena, which vessel took General Lawton and General Wheaton on a reconnoissance along the beach. The two generals and Capt. Sewall, U. S. V., climbed into the fighting-top, and then the Helena, with decks cleared for action and all guns manned, slowly ploughed her way through the soft mud within eight hundred yards of the shore-line. With good binoculars and long glasses, we carefully examined the country from Las Piñas to the Imus River, and located the trenches, roads and bridges, and also two muzzle-loading rifles of about six-inch caliber, which were mounted behind well-constructed earthworks near the corner of the church in Bacoor. These guns were trained on the Naval Station, but their arcs of train appeared very limited. A breech-loading six-inch rifle had

also been stolen from the Cavite Arsenal after the evacuation by the Spanish, but a careful examination of the beach failed to locate it, although this was the gun which, according to the rumors of the Amigos, had been promising for weeks to destroy the Naval Station. Many Filipino soldiers were seen in trenches along the shore, and sentries were posted at prominent points. Upon the approach of the Helena, these men sought cover behind earthworks or nipa huts; but not a shot was fired, and we did not disturb them, as we were merely studying the country. We saw in the trenches a number of men belonging to the far-famed "red-legged regiment"—Aguinaldo's body-guard—a Filipino regiment that had been in the service of Spain. After a conversation with General Lawton, the commander-in-chief told the captain of the Helena to fire a shell occasionally into the Insurgent trenches during Monday night in order "to keep the Insurgents awake and their nerves on a tension." During this reconnoissance, a steam launch came alongside with a Spanish lieutenant and three Spanish non-commissioned officers who had escaped from the Insurgents' prison at San Francisco de Malabon and surrendered to the Wheeling. The Spanish lieutenant was taken up into the fighting-top, where in General Lawton's presence he was questioned about the country and the location of the Insurgent forces. He pointed out fortifications along the shore, but said the Zapote River was the Insurgents' stronghold and that they had sworn to make a stubborn fight to prevent our troops crossing that river into Cavite Province. He stated, further, that the entrenchments along the Zapote River were very formidable, being on both sides of the river, and were defended by machine guns and the crack regiments of the Filipino army. The swamps, rice-fields, and dense under-brush increased the strength of the enemy's position and made the two bridges across the river very secure. He said that Aguinaldo's brother and General Mariana Trias were in command and had between four and five thousand men in the province; they also had some six-inch rifles, but he did not know their location, although he had heard that they were mounted in positions to bear on the Naval Station. The military headquarters of the province and the plant for manufacturing powder were being moved from Imus to San Francisco de Malabon.

After this reconnoissance, the writer took the Spanish pris-

oners to the headquarters of General Otis in Manila. The general had already received, through scouts and Filipino spies, information that corroborated, in a general way, the Spanish lieutenant's statement about the Zapote River. General Otis said the enemy held a very strong position on the Zapote River and they had "sworn by everything holy'" to prevent our forces crossing. It was in the Zapote River swamps that the Insurgents in 1896 had ambushed and slaughtered a large force of Spanish troops, and they expected to serve us in the same manner.

The Spanish lieutenant and his men had been prisoners for thirteen months, having been captured when attempting to reach Manila after the evacuation of the Cavite arsenal. They were very bitter against the Insurgents. Their physical condition and their clothing did not indicate very kind treatment. It was really quite touching to hear their expressions of delight and gratitude over being in friendly hands once again and to see their eyes fill with tears as we steamed up the Pasig and they caught sight of the "Stars and Stripes" proudly floating from the staff where previously they had seen the flag of Spain.

General Otis sent word to the commander-in-chief of the fleet that there would be no general advance of the army in the direction of the Zapote River next day (Tuesday), as it was necessary to send reinforcements and supplies to Las Piñas. However, General Lawton decided to make a reconnoissance, the next morning, of the approaches to the Zapote River bridge, and the ships were ordered to clear the way for his scouts. The advanced scouts were to carry signal flags to mark their positions, and to serve as guidance for the ships in firing. The early morning of June 13 found the flagship Baltimore protecting the city of Manila; the Monadnock between Las Piñas and Zapote River; the Helena directly off the Zapote River; the Manila, Lt.-Comdr. A. P. Nazro, between the Zapote River and Bacoor; the Callao off the mouth of the Imus River; the Monterey and Princeton protecting the Naval Station; while the Wheeling, Basco and Urdaneta were controlling the Isthmus.

General Lawton made an early start on his reconnoissance on June 13, being accompanied by his adjutant-general and two companies of unmounted troops. The ships were soon underway to take positions covering his advance. The Helena's light draft permitting her to go very close inshore, she forced her way

slowly through the soft mud and shelled the beach ahead of the scouts. Soon after the Helena opened fire, the much-talked-of six-inch rifle of the Insurgents fired on the Callao and on the Naval Station. One shell ricochetted over the Callao, while another struck the shears at the Naval Station, failed to explode and dropped into a coal-pile. The moment the enemy's gun fired and disclosed its masked position, the Monterey, Princeton and Callao opened such a terrific fire upon it that it was abandoned after its second shot. This gun was mounted in a nipa hut at the mouth of the Imus River, where the Spaniards formerly had a fort and magazine. The Monterey also opened on the two muzzle-loading rifles and disabled them before they fired a shot. One twelve-inch shell from the Monterey completely buried one of the guns, and then on the ricochet took out the end of a church in the rear.

The ships commenced firing all along the line, and the Insurgents opened on them from their beach-trenches. The Mauser bullets were snipping the water and flattening themselves against the sides of our ships, while we were paying our respects with shrapnel, machine guns, and Lee rifles.

General Lawton's reconnoitering party advanced steadily along the beach and planted their signal flag on a point near the mouth of the Zapote River, when suddenly they encountered a strong force of Insurgents in concealed trenches. A hot fire was poured into them from the enemy's trenches, and after a stout resistance, they rallied on the point and lay down on the sloping beach. General Lawton left his men in command of his adjutant-general to hold this strategic and advanced position, while he hurried back to order a general advance of his main force. The Helena, Monadnock and Manila were firing briskly over the heads of our troops into the Insurgent trenches, and their fire was being returned in spirited volleys. The commander-in-chief, accompanied by Captain Forsyth and the writer, was steaming from ship to ship on the firing-line in the little tug Barcelo, and had just left the Helena about the noon hour, when the army's advance guard signaled that vessel: "send support if possible," and followed with a message that they had very little ammunition and no water. Without interrupting their fire, the Helena and Monadnock immediately called away landing parties, and within ten minutes' time had a force of ninety men armed as infantry,

and with a Colt gun, on their way to the shore. The little gunboats and ships' armed launches went close in shore and covered the immediate landing with their machine guns, while the ships threw shrapnel over and beyond them. Lieut. Edw. Moale commanded the Helena's landing force, Lieut. F. R. Payne that from the Monadnock, while Lieut. Cleland Davis, with the Helena's steam launch, ably assisted their landing.

In a remarkably short time our men had landed, reinforced the army's small advance guard, and opened with their Lee rifles and the Colt gun. The Helena also sent water and bread to the soldiers on the beach, and her boats brought on board some of the army's wounded. The rapid landing of the forces from the Helena and Monadnock illustrated the high state of efficiency of the vessels, and there was not a mishap to mar its success.

Spirited firing continued throughout the afternoon, but the *combined force* on the beach supported by the ships held the superior force of the enemy in check. In the meantime, General Lawton's main force was advancing, and between four and five o'clock he struck the Insurgents' trenches along the Zapote River. Soon the fierce fusillade was intermingled with wild cheers, and we knew that our troops had assaulted the enemy's stronghold. The Insurgents retreated from the trenches near the beach, and the men of our landing party advanced with their companions of the army to the banks of the Zapote. The enemy withdrew rapidly in the direction of Bacoor, and our ships severely harassed their disorderly retreat. The landing force returned to their ships about dark without a casualty. General Lawton sent the following signal to the Monadnock (the vessel nearest the army signal station) for transmission to the commander-in-chief: "Battle carried the bridge, crossed the river; enemy completely routed. I appreciate assistance of the navy which I will with pleasure acknowledge later officially. Lawton, Major-General commanding."

General Lawton's forces rested for the night in complete possession of the splendid fortifications along the Zapote River. General Lawton and his adjutant-general were most generous in their commendation of the navy's work, and seemed exceedingly grateful for the landing force which so quickly reinforced the exhausted reconnoitering party on the beach, and supplied them with water and bread. It was stated that the fire of the ships and

the combined force on the beach held one thousand Insurgents in check in the beach-trenches and prevented them from joining the main line of defense—thus enabling our troops to break through the gap in the enemy's line and enfilade the trenches. Thus, the holding of this advanced position proved the key to the Insurgent trenches; and General Lawton's skill in so quickly taking advantage of the situation achieved a brilliant victory.

Even that admirable soldier and veteran Indian fighter, General H. W. Lawton, regarded this as one of the most severe engagements of his life, the Insurgents having stubbornly held their trenches until our troops charged, and enfiladed them at very short range with artillery fire.

Filipino prisoners and escaped Spaniards estimated the enemy's loss at two thousand killed and wounded—but it was probably one-half that number—and they reported the Insurgents completely demoralized and retreating through Bacoor.

Without doubt, this was the most severe battle of the insurrection, and, although the Filipinos fought courageously, they could not withstand the terrific onslaught of General Lawton's columns and the withering shrapnel and machine-gun fire of our ships.

During the night of June 13, the search-lights of our vessels detected squads of retreating Insurgents, and an occasional shrapnel dropping in their midst made their retreat more precipitate.

Early next morning the native market-boats reported Bacoor abandoned and the enemy retreating to Imus; also, that many had been killed or wounded by the shrapnel fire of the ships. Later in the morning, a boat from the Helena landed at Bacoor and found the outposts of General Lawton's division. Much damage had been done by our ships, and a number of the enemy's dead had been left behind.

While the navy's main firing-line was engaged off Zapote River, the Wheeling was again shelling the returned Insurgents out of the trenches beyond the Isthmus of Dalahican. She drove them out, and then her armed steam launch steamed close along the shore and drove them beyond the range of her machine gun.

It was not many days before Imus, the former capital of Cavite Province, was occupied by General Lawton's forces. At last, the shore-line between Manila and the Cavite Naval Station was clear of Insurgents. The gratifying result of the campaign in Cavite

Province proved the splendid cooperation of the army and the navy in a campaign where success depended upon efficient cooperation.

For some unaccountable purpose the newspapers of Manila barely mentioned the presence of a few ships during the Zapote River campaign, and though our home papers contained many vivid descriptions of the land operations in this campaign, the navy's thorough and invaluable cooperation has not been published.

The Insurgents' gun and the shell it landed in the Cavite Naval Station will soon occupy a place among the war trophies at the U. S. Naval Academy.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE LANDING AT BAIQUIRI.

By JEAN LEGRAND.

"La Marine Francaise," June, 1899.
Translated by Lieut. F. A. Traut, U. S. N.

Nearly a year ago, we called attention in this Review to the fact that the disembarkation of the body of troops which brought about the capitulation of Santiago was much inferior, both as to preparation and execution, to similar operations carried on by the Japanese in their recent war. We now return to this subject, being amply supplied with official information: the study of the errors committed by others should teach us to be on guard and to pledge ourselves not to improvise solutions of problems which, in spite of the conference at the Hague, will present themselves in the future.

The original plan of the Americans seems to have been to attack and to reduce Havana. The news of the departure of Cervera's squadron interrupted their preparations; on the third of May, Long telegraphed to Sampson that nothing would be done until it was known where this squadron was going. If its objective was Puerto Rico, it would be there about the 8th of May and should then be attacked at that place. The conference at the White House had fixed upon 40,000 men as the strength of the expeditionary corps, which, it flattered itself, could be organized in fifteen days; then, after the 15th, orders were given countermanding this. The uncertainty which governed Cervera's plans prevented carrying out the preparations which had been begun. In the meantime, on the 20th the War Department expected soon to have thirty transports at its disposal at Tampa.

Just at this time news is received of the presence of Cervera

at Santiago, and with a perfectly clear conception of the situation, it is decided that his ships must be captured there, and that, furthermore, an expeditionary force capable of reducing the city must be transported.

On the 31st, the Navy Department inquires of the War Department as to the ways and means which will be employed for the landing of the troops and war material, and advises it that the crews of the men-of-war cannot be detached for this purpose from their duties on board ship, where they are awaiting opportunity of offering battle to the Spanish admiral.

The expeditionary corps, estimated at 25,000 men, is waiting only, it is said, to be assured that the whole of the enemy's squadron is really in Santiago, before putting to sea.

Commodore Remey, commanding the naval base at Key West, organizes the escort. He sends only a few ships to Tampa, in order that they shall not exhaust their supplies. The others are to join at Tortugas.

Elsewhere, Commodore Watson, who is blockading the north coast of Cuba, redoubles his vigilance, in order to oppose any sortie of the Spanish gunboats.

On the 2nd of June, General Shafter announces that he will sail in two days, when the strength of his forces shall have reached 18,000 men (there was talk of 25,000 the week before!).

Measures are taken to prevent the curious, notably the press-boats, from following the convoy. They are to be kept away.

Information is obtained regarding the strength of the enemy, who is said to have 7000 men at Juraguacito, otherwise known as Siboney, 5000 at Morro-de-Cuba, and 900 men in detachments in the batteries and with 37 mm. Hotchkiss guns and torpedoes. It is to be noted that, in reality, the forces stationed in the province did not exceed 8000 men and that Santiago was defended by 2968 men, to-wit:

	Men.
Landing parties from the squadron	458
Four companies of the battalion of Puerto Rico	450
Battalion of Talavera	850
Four companies of San Fernando	440
Three companies of "mobiles"	330
Finally, the volunteers	440
Total	2968

Be that as it may, on the 7th of June, Sampson telegraphs from Santiago: "We have bombarded the forts from 7 until 10 o'clock in the morning and have rapidly silenced their fire, at 2000 yards, without receiving any damage. If there were 10,000 men here, the city would be ours in 48 hours!"

The army is just about ready and the escort awaiting impatiently the signal of departure, when there is a sudden alarm in the form of a telegram from Remey, on June 8:

"A Spanish armored cruiser, a second-class cruiser, and a destroyer have been sighted by the Eagle, near Nicholas Channel, and several hours later the news was confirmed by the Resolute, which has arrived. She was chased by the two ships last night. Shall I send the Indiana and all available cruisers in reconnaissance?"

Under the influence of this sudden surprise, people ask if Sampson has not allowed some vessel to escape; he is enjoined to send back his two armored cruisers.

Here are the details of the appearance of those two phantom vessels: At 9.45 in the evening, the Eagle sighted the stern light of an armored cruiser; she twice makes the signal of recognition, the other displays lights which are answered by a protected cruiser and two destroyers. The Eagle steamed up abreast of them until it was certain that they were Spaniards. She communicated with the collier Lebanon, telling her to notify Sampson, and then returned as quickly as possible to Key West. One of the torpedo-boats chased her for some time . . .

Here is evidently a disagreeable *contre-temps,* but upon considering the matter, it can be disposed of by reinforcing the convoy. Remey has the sea searched in every direction. Officers even land on the Cuban coast, searching for information.

On the 8th, the Department, with great good sense, demands certain explanations. How were the ships in question recognized as being Spaniards, or as armored or unarmored? And here already we have the Resolute less affirmative—she saw nothing but lights. But the other one holds out; captain, officers, crew, all are agreed, having observed the enemy for half an hour at the distance of a mile.

Immediately, a monitor is despatched to Havana, the cruisers at Tampa are reinforced to the number of four, and a field battery is established at the end of the jetty!

On the 10th of June, Sampson replies in the most sceptical manner, all the time inveighing against the unforeseen delay.

Finally, on the 12th of June, it is announced that the vessels seen by the Eagle were the Armeria, Scorpion, and Supply, which had been exactly in that position at the time specified.

Finally, on the 12th of June, there are thirty-seven transports and lighters gathered at Tampa. A new delay which is now to occur is caused by the difficulty experienced in renewing their supply of fresh water. They are protected by the Annapolis, Castine, Helena, Hornet and Resolute.

They are to rendezvous at Rebecca Shoals with the Indiana, Detroit, Bancroft, Wasp, Eagle, Osceola, Wompatuck, Manning and two torpedo-boats, the Ericsson and Rodgers. It will be necessary to keep a sharp lookout. It is reported that there are five small Spanish cruisers at Puerto Rico!

And, in the meantime, the battalion of marines landed at Guantanamo is pressed so closely that Sampson makes the most urgent demands for reinforcements.

Finally, at half-past eight on the evening of the 15th, the transports arrive in disorder, at seven knots' speed, at the rendezvous where the convoy is awaiting them. Every night, the column is so extended that the end is lost sight of; a lighter with a pair of sheers and a tank-vessel, which are being towed, cause continual trouble. The commander would like to close the intervals, but this cannot be done until clear of the Bahama Channel.

The mules on board the Julia are dying of thirst. The City of Washington loses the rest of the convoy and is only partly reassured by the presence of the Bancroft. On the 18th, they both sight a large steamer coming towards them. Instead of answering signals, she goes about. She is fired upon and decides to tell who she is. It is the Yucatan, with the Rough Riders, sent, it appears, by the commander in search of the stragglers. It is more than likely that these gentlemen were in search of "excitement." Needless to say, Captain Taylor, the commander of the convoy, knew nothing of this pretended mission. As for him, he was very much occupied in having the coast-line watched by one or two cruisers. Commodore Watson, in person, cruised for two days with the Montgomery inshore of the convoy.

Finally, one thing helping another, on the morning of the 20th, sixty vessels stopped 15 miles off Baiquiri.

Admiral Sampson's chief of staff, having come out in the Gloucester, conferred with the commanding general.

He brings with him a chart and explains to the general that in order to enable the squadron to go in, it will be necessary to take the positions occupied on both sides of the harbor entrance by the enemy's batteries.

The possession of these points will ensure the destruction of the torpedoes and the attack upon Cervera at the anchorage. General Shafter acquiesces in this plan.

Baiquiri was then definitely fixed upon as the point of disembarkation. The transports were assigned their stations. The men-of-war were assigned the duty of getting them into this formation and of rectifying it at all times.

In the meantime, the convoy was covering itself with signals of distress, asking for the fresh water which the tank vessel was distributing. The convoy lay to all night and there ensued an indescribable confusion.

The next day, the commanding general wished to call the corps and division commanders on board the Seguranca, but no one paid any attention to the signals. Quite late in the afternoon, it was found necessary to have the Bancroft make a round of the ships; and with the greatest difficulties, on account of the state of the sea, she took on board a dozen officers who were little familiar with that sort of operation. Two of them tumbled into the water. Colonel Van Horn, having misjudged his time, let himself drop from the height of fifteen feet into the boat—he subsequently died from the effects of it.

The conference finished, the next thing was to get back to their respective ships. But the captain of the Indiana had decided to keep underway during the night—steaming towards the southward until midnight—for the purpose of maintaining some sort of order.

It thus became a most dangerous operation to have these vessels stop, in column, after having found them by the aid of a search-light. The colonels and generals had to resolve themselves to pass a most uncomfortable night on board the Bancroft.

Meanwhile, General Shafter had notified the admiral of his intention to commence disembarking his troops. Sampson directed the captain of the St. Louis to proceed with the latter, using the following boats:

St. Louis, 13 life-boats, 10 collapsible boats;
Massachusetts, 2 steam launches, 5 cutters, 2 whale-boats;
Iowa, 2 steam launches, 1 whale-boat;
Brooklyn, 2 steam launches, 1 sailing launch, 3 cutters;
Oregon, 2 steam launches, 1 sailing launch;
Annapolis, 1 steam launch;
Indiana, 1 steam launch;
Detroit, 1 steam launch;
Texas, 1 steam launch, 1 cutter.

Namely, 12 steamers for towing, 3 sailing launches, 10 cutters, 4 whale-boats and 23 boats from the St. Louis. Total, 52 boats.

* It is to be noted that the squadron could and, perhaps, should have furnished many more. This depends on whether the length of shore-line available for disembarkation would have permitted their use.

The captain of the St. Louis had made the disposition set forth in the following order:

1. The boats of the squadron assigned to the duty of landing the army will assemble near the St. Louis, off Baiquiri, at 4.30 A. M. The senior officer in charge of the contingent from each ship will report on board the St. Louis for orders.

2. Each boat will have a coxswain and from two to four men, according to size. They will be provided with an answering pennant on a staff.

3. The officers in charge of boats will repair alongside the transport designated in their written orders and will embark passengers in the boats, approximately as follows: steam launches, 15; sailing launches, 70; life-boats, 45; cutters, 25; whale-boats and gigs, somewhat less.

4. The boats will be loaded carefully; the first men coming on board will be required to sit down in the bottom of the boat. Those on the thwarts will, under their officers, be prepared to fire on the enemy. Avoid overloading the boats.

5. As the boats are loaded, they will push off and be taken in tow by the steam launches. The steam launches will then form in line abreast, to the southward of the Wompatuck.

6. The heavier boats will go next the steam launches.

* All other boats were left at Key West.—Editor.

7. When the blue-peter is hauled down on board the Wompatuck, the flotilla will follow in her wake.

8. It is intended to prepare a landing-stage, to be towed by the Wompatuck. If this intention is realized, the troops will debark on the stage. Possibly, a pier now existing at the point selected may be available. Or, if it cannot be arranged otherwise, the troops will land from the boats directly.

9. In any event, a blue and red flag hoisted on the Wompatuck will be the signal to land, when the detachments will go ashore in the following order: first, that from the Seneca, in the order designated by Colonel Van Horn; second, that from the Arizaba (24); third, that from the Manteo (36); fourth, that from the Knickerbocker (13); that from the Iroquois as directed by General Lawton.

10. The boats awaiting their turn at landing, and especially the steam launches with their rapid-fire guns, will clear the vicinity of the beach of the enemy.

11. An orderly and deliberate procedure in disembarking will be found an economy of time. If there be any surf, the army officers in the boats will designate their men by name in the order of disembarking. The officer or coxswain of the boat will provide for this before leaving the transport.

Let us see how this program was executed.

At 4.30 in the morning, the St. Louis went within a mile and a half of the harbor of Baiquiri, in order to show the transports that there was sufficient depth of water. The boats did not arrive until two hours later, in tow of the Suwanee and Wompatuck. Some of the steam launches even came under their own steam. It was not until nearly nine o'clock that an advance upon the landing-place could be contemplated. As soon as the first of the troops were embarked in the boats, the Indiana had hauled down the pennant of the commander of the convoy and had stood towards Santiago, by the express order of Admiral Sampson. Neither men nor officers being familiar with this sort of work, the loading and taking in tow of the boats became a very laborious operation. The transports were lying so far off that much valuable time was lost in getting to them. One of them, the Knickerbocker, failed to appear and the division of boats—composed of 4 steam launches and 11 cutters—which was intended for her 600 men, searched for her in vain. She did not

appear until late in the afternoon. The captain of the St. Louis had gone on board the Wompatuck. The prearranged signal was hoisted, and accordingly, the ships New Orleans, Detroit, Castine and Wasp opened a fire on the shore heavy enough to destroy the whole Spanish army,—if it had been there! There was no reply. Besides, this fire would have been incapable of sweeping a country so cut up and offering hundreds of ambuscades from which one could command the wharf in perfect security. The Wompatuck and her satellite, the Suwanee, also fired a few shots into the woods to the west of Baiquiri. Fortunately, there was no resistance, and still more fortunately, the little harbor was found in good condition. On the other hand, it was impossible to get more than two boats alongside at a time and so this operation, hindered by the swell, was discouragingly slow. At six o'clock in the afternoon, there were hardly 6000 men on shore, representing not quite three trips for every boat. There is no doubt that if the transports had not lain from two to five miles out, things would have gone much better. An attempt was made to land directly on the beach, but several boats were thrown upon the rocks and one of them, belonging to the Brooklyn, was completely destroyed. In the afternoon, the beach-master was able to organize a more systematic method of discharging the boats and stopped the transporting of troops in the steam launches, since the latter lost so much time in getting alongside. The following day, the various points were recognized, in regard to which there had been a total lack of preparation, and measures were taken to properly provide for them. General Shafter placed the officers of the merchant vessels under the orders of the captain of the St. Louis, of which the latter took advantage by making them anchor close to the shore, near Siboney, where the disembarkation was to be continued; furthermore, the steam lighter Laura, which carried 300 men, ferried the troops across this short distance and landed them by means of two sailing launches loaned by the navy and directed by Colonel Weston. There was no wharf at Siboney. A normal speed of landing 600 Americans or 1000 Cubans per hour was reached. The wharf at Baiquiri was, moreover, in bad condition and it seems remarkable that no effort was made to repair it or keep it in order, or to see to the building of a new one—like the Japanese under similar circumstances.

The result appeared to be sufficiently satisfactory for reducing the number of steam launches on the 24th to five and to send back the Oregon's boats. The operations were continued during the night, thanks to the search-lights of the St. Louis, which ship, thanks to her resources of all kinds, rendered the most valuable service. She berthed the men from the squadron, hoisted at her davits all the boats not in use, coaled, watered and repaired the steam launches, and furnished them with relief crews of machinists and firemen for night duty. The question also arose of landing the mules of the engineer corps. They had to content themselves with putting them overboard alongside, in the hope that they would gain the shore, but some of them swam out to sea, and since there was no boat detailed to look out for them, they were lost. About fifty were drowned in this manner. As to supplies, ammunition, etc., the landing of these was carried on in an exasperatingly slow fashion and was dependent entirely upon circumstances.

At last, on the 26th of June, in the afternoon, the St. Louis rejoined the squadron off Santiago with all the boats, her special duty having been completed.

From the disorder of this expedition—henceforth a matter of history—we may draw the following conclusions:

1. In a convoy, there must be unity of command and it cannot be embodied in any one but the commander of the escort.

2. In order to convey his directions to the captains, it will be necessary to have on board of each chartered ship one midshipman and two signalmen.

3. In order to simplify the conduct of the convoy, each man-of-war should have charge of a group of merchant vessels whose movements will be regulated by her.

4. It is absolutely impossible to take along such floating material as pontoons, lighters, tank vessels, without running the risk of innumerable delays and annoyances.

5. The commander of the convoy must be identical with the officer in charge of the operation of debarkation.

6. Unopposed landings only should be attempted.

7. The speed of the operation is a function of the distance to the landing-place and of the relative number of boats and length of available landing-place.

8. A body of troops is landed, for the purpose of taking posses-

sion of a port, and, in this port are subsequently landed the artillery and stores of this body of troops.

9. In order to carry out a successful debarkation, it is necessary to have practiced it before—under any other conditions, the most minute theoretical preparations will not accomplish the end in view.

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THE WAR AND ITS LESSONS.

By COLONEL SIR G. S. CLARKE, K. C. M. G., F. R. S.

The year 1898 saw the English-speaking peoples engaged in warlike operations in regions widely separated. The conditions of the contests differed organically; but the objects were essentially similar. In both cases, strikingly complete success was attained, and while the disappearance of the remnants of the colonial empire of Spain is fraught with far greater consequences to the world than the overthrow of Dervish rule in the Eastern Sudan, the principal result is to increase the responsibilities of nations owning a common origin and upholding a common standard of progress and of liberty. This fact alone suffices to invest the wars of 1898 with peculiar significance, and to render their lessons specially important to the two English-speaking peoples.

From the days of the Armada, it has been the ill fate of Spain to be frequently brought into collision with the British Navy. This has been caused directly by the struggle for colonial dominion which, beginning in the days of Elizabeth, assumed great dimensions in the wars of the 18th century, and indirectly by French alliance, voluntary or enforced, which have entailed nothing except loss of territory and naval disasters upon Spain.

The conquest of Jamaica by Penn * and Venable in 1655 marked the dawn of the expansion of England. It is an exceedingly interesting historical development that the over-sea expansion of the great nation which owes its birth to England should have followed similar lines. The events of 1898 offer another an-

* Father of the founder of Pennsylvania.

alogy with the older Spanish wars. The story of Jenkyns's ear was probably a fable; but it is clear that accounts of Spanish cruelties and especially of the enormities alleged against the Inquisition which Spain imported into her colonies powerfully impressed the imagination of the British people and aroused their strong resentment. The spectacle of hopeless misrule of Spain in Cuba, with the wanton destruction of life and property which it entailed, forcibly appealed to the humanitarian instincts of the American people. A great nation cannot continue to contemplate with equanimity chronic disorder in closely adjacent territory with which its interests are closely involved, and intervention sooner or later was obviously inevitable when the destruction of the Maine, lying at anchor under the protection of the Spanish authorities, precipitated the issue. No government could resist the popular will in such a case and on April 21, Congress declared war.

The theatre of operations by sea and land is classic in British history. The West India Islands and the waters of the Caribbean Sea had been the scenes of innumerable military and naval conflicts. Manila, San Juan, Havana and Santiago had all been attacked, and Santiago alone had escaped British occupation. Almost exactly 301 years before Admiral Sampson's squadron arrived off San Juan, the place was captured by the Earl of Cumberland after operations closely resembling those recently carried to success at Santiago. San Juan, in 1597, is described as being "very much bigger than all Portsmouth within the fortifications and in sight much fairer." Its defenses were reported "to the sea very strong and fitted with goodly ordnance, and bestowed for the most advantage to annoy an enemy that can possibly be devised." The ships, therefore, made no attempt to enter the harbor, and success turned upon the land attack. The Spaniards, said the British commander, "will make a great show, and perhaps endure one brunt; but, if they do any more, tear me to pieces." After the occupation of the town, the garrison of the Morro accepted the following terms of capitulation:

A resolution which you may trust to. I am content to give yourself and all your people their lives; yourself with your captains and officers to pass with your arms; all the rest of your soldiers with their rapiers and daggers only. You shall all stay here with me till I give you passage from the island, which shall be within thirty days.

This arrangement of 1597 finds a close parallel in 1898. In 1757 and again in 1762, Manila was taken by a British force. On the latter occasion, 10 ships of war under Rear-Admiral Cornish and a landing force of 2300 men under Colonel Draper were employed. The town itself was ransomed for four million dollars, of which the Spaniards only paid half. The Filipinos of this date, armed with bows and spears, are said to have displayed great fighting qualities on the Spanish side and to have "boldly rushed on the very muzzles of our pieces." About the middle of the 18th century the possession of Cuba seems to have been ardently desired in England. "Take and hold, is the cry," wrote William Pulteney to Admiral Vernon in 1740, "this plainly points to Cuba, and if the people of England were to give you instructions, I may venture to say, ninety-nine in a hundred would be for the attacking of that island." The combined expedition under Vernon and General Wentworth, after failing in an attempt to take Cartagena, was directed against Santiago, in July, 1741, in defiance of sound principles. A considerable Spanish squadron lay at Havana which was watched by cruisers. The landing was effected in Guantanamo Bay and a hundred American troops were the first to be put on shore. The military forces remained for three months in the neighborhood of Santiago; but nothing was accomplished, and after mutual recriminations between the admiral and the general, the expedition was ignominiously withdrawn. The Spanish squadron at Havana maintained a masterly inactivity and there is little doubt that Santiago could have been taken; but the conquest would have been unimportant. In April, 1748, Santiago was again attacked by Rear-Admiral Knowles with eight ships fresh from the capture of Port Louis. Captain Dent of the Plymouth, 60-gun ship, led in towards the harbor, but the Spaniards had blocked the channel with a boom, and after a fruitless engagement with the forts, the squadron withdrew. For this failure Captain Dent was tried by court-martial and acquitted. In June, 1762, Havana was attacked by Admiral Sir G. Pocock and an expeditionary force of 10,000 men under the Earl of Albemarle. American troops from New York arrived later * and took part in the siege of the Morro. On July 1, the Cambridge (80), Dragon (74) and Marlborough (70) engaged the

* The American contingent "came very seasonably and was of great service."—*Annual Register.*

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defenses for seven hours and were withdrawn much damaged with a loss of 176 men. On July 30, the Morro was stormed and on August 13, Havana, with nine ships of the line, capitulated. By the Treaty of Paris in the following year, Cuba and the Philippine Islands were handed back to Spain in exchange for Florida and the right of cutting logs in Honduras. Destiny, foiled in 1763, has now reasserted itself, and the future of Cuba and of the Philippines rests with the English-speaking peoples. The American troops who landed in Guantanamo Bay in July, 1741, were the precursors of the marines who disembarked on the same shore on June 10, 1898.

The primary conditions on the outbreak of the war of 1898, were comparatively simple. Foreign complications could be safely ignored in view of the attitude of Great Britain and of the extreme reluctance of European powers, harboring pro-Spanish sympathies or designs upon Spanish territory, to take any step which might lead to a British naval demonstration. This, however, was not at the time realized in the United States. The objects of the war demanded intervention in Cuba. Havana, the center of Spanish power, was therefore, as in 1762 and as ought to have been the case in 1741, the primary objective. Until the naval situation was assured, however, nothing could be attempted on Cuban soil, nor could the maintenance of an effective commercial blockade be counted upon. Such is the plain teaching of all history. The Spanish ships of war in Cuban ports could be safely disregarded, and the main question, therefore, was as to the measure of naval strength which Spain could bring to bear in West Indian waters from her home ports, 4000 miles across the Atlantic. Accurate information of the state of the Spanish Navy was unquestionably available at Washington, although the hopeless unpreparedness since revealed may not have been fully realized. If the Spanish fleet had approximated in reality to its paper strength, the task of contending with the American Navy in its own waters would have been difficult. In the actual conditions, that task was impossible; but an inferior fleet well found and well handled is capable, until defeated or closely blockaded, of preventing such operations as the United States were called upon to undertake in Cuba. Was this minor task possible to the Spaniards?

At the moment when war was declared, Admiral Cervera's

squadron of four armored cruisers, three destroyers and three torpedo-boats lay at St. Vincent, Cape Verde Islands. The Spanish government had apparently already decided that it was necessary, for political reasons, to send a naval force to Cuba; but this was not known to the admiral, who wrote on April 22:

> It is impossible for me to give an idea of the surprise and astonishment experienced by all on the receipt of the order to sail. Indeed, that surprise is well justified, for nothing can be expected of this expedition except the total destruction of the fleet or its hasty and demoralizing return; when here in Spain it might be the safeguard of the nation.*

The state of the squadron amply justified this forecast, which was perfectly accurate except that a "demoralizing return" was exceedingly improbable. Even ships so little fit for purposes of war as those of Admiral Cervera would have been of value in protecting the coast-line of Spain from a raid across the Atlantic such as naturally presented itself to the minds of instructed Spanish officers. After a delay of eight days, which told its tale to cool observers, the Cape Verde squadron went to sea.

In the United States, the most exaggerated fears found expression. The Atlantic seaboard was assumed to be in danger and panic measures were adopted. Writing in 1897,† Captain C. F. Goodrich, U. S. N., gave specimens of the flood of excited telegrams which invaded Washington in 1861-63, and drew attention to "the wisdom and firmness displayed by the Secretary of the Navy . . . Mr. Welles's contention was, in effect, that the harbors of New York and Boston were guarded by the vessels of the blockading fleet which stretched from Cape Henry to the Rio Grande, a surprisingly broad and sound strategic view, from which he appears never to have wavered." At the same time, Captain Goodrich expressed a doubt "whether, in the event of war in these days, a Secretary of the Navy can possibly be as independent in his action as was Mr. Welles." By far the most important lesson of the war—to the United States and to Great Britain—is the danger that uninstructed public opinion may usurp the direction of naval policy. At the beginning of this century the people of England had learned by experience many of the principles of naval war; but tendencies, such as were manifested

* Papers translated in the office of Naval Intelligence.

† *Naval Raids.* Proceedings U. S. Naval Institute.

in 1898, had not been wholly extinguished. "Only think," wrote Reppel to Saumarez, "what alarms we shall have and how much our cruising will be interrupted if any more invasions are trumped up, which they will be in the winter, so that their (the French) Martinico ships may pass safe." Similarly, Lord St. Vincent significantly complained of the influence exerted by "the fears of the old women of both sexes." In 1898, public opinion, not strategic principles, determined the preliminary naval proceedings of the United States in the Atlantic. Governments, like those of Russia and Germany, which are not accessible to the influence of a popular outcry, have an undoubted advantage in conducting operations of war.

At the end of April, the naval attitude of the powerful belligerent was one of anxious and passive expectation, while its weak and ill-prepared opponent was undertaking what appeared to be an offensive movement into far distant waters. At the same time popular opinion in the United States, though powerfully impressed with the idea that New York, Boston and Philadelphia were in imminent danger, demanded an immediate invasion of Cuba, and 5000 picked regular troops were prepared for embarkation. If the naval situation had really been such as to imperil the Atlantic coast-line, it would have been madness to have undertaken over-sea operations, and the project of sending the first expeditionary force to sea on May 4 was abandoned.

It is abundantly clear that American naval officers were not in the least imbued with the prevailing alarms, and as early as April 9, Admiral Sampson, with the true instincts of the sailor, wrote to the Secretary of the Navy:

> I sympathize with all you say about guarding our big ships against a possibly serious loss while the enemy's fleet is still intact. At the same time, I regard it as very important to strike quickly and strike hard as soon as hostilities commence.

Popular theories of the potentialities of the Spanish fleet, however, forbade any strong naval measures, and in deference to these theories the United States force was divided, the Flying Squadron being retained at Hampton Roads in the hope of allaying the fears of the press and the people. The genesis of the Flying Squadron may in fact be traced to an uninstructed outcry. On April 29, Admiral Cervera sailed, and with an ocean speed of

10 knots only could have reached San Juan on the 9th of May. On this date, Admiral Sampson was proceeding slowly to Puerto Rico much hampered by the monitors Terror and Amphitrite. Commodore Schley was at Hampton Roads and a weak blockade of Havana and part of the Cuban coast-line existed. The object of Admiral Cervera was merely to evade the United States Navy and to reach a Cuban port. He, therefore, avoided San Juan and steamed straight to Martinique, arriving off the south side of this island on May 12 and, after communicating with Fort de France and leaving there the destroyer Terror, he proceeded to Curaçoa. Here he missed a collier which had been directed to meet him and steaming northwest arrived at Santiago on the morning of May 19. His squadron was sighted off Martinique by Lieut. Kane of the U. S. S. Harvard, and reported by telegraph. Its arrival at Curaçoa was notified by an American passenger on board a British steamer. Important news was thus obtained mainly by good fortune. The evident want of system in the scouting operations was doubtless due to the fact that they were not controlled by the commander-in-chief alone. If a mixed control had not been substituted for unity of command, Admiral Cervera's squadron would probably have been sighted before it reached Santiago. Meanwhile, on May 12, when Cervera was nearing Martinique, Admiral Sampson was bombarding the defenses of San Juan. Neither reason nor the experience of war justified any hope of effective results and, if the Spanish gunners had known their trade, the United States ships would unquestionably have suffered injuries which might have proved exceedingly inconvenient. As it was, the admiral withdrew after a large expenditure of ammunition and reported "the United States fleet in great need of repairs," while the Spaniards were enabled to claim a victory. If the squadron had been well to the eastward when war was declared and had struck at San Juan on April 23, when the Spanish preparations were in a backward state, a success, which would have had definite strategic significance, was perhaps possible.

The important news from Martinique and Curaçoa caused a rapid change in the situation. The Flying Squadron could at length be moved south, and after coaling at Key West, it sailed for Cienfuegos on May 19, at the very moment when Cervera was entering Santiago, and was followed next day by a reinforce-

ment consisting of the Iowa and Castine with the collier Merrimac. Admiral Sampson's force, which had returned to Key West, sailed on May 21 to join the Havana blockade, receiving news on the 22d that the Spaniards were at Santiago on the previous day. On May 23, the squadron steamed eastward and cruised in the Nicholas Channel in order to cover the approach to Havana, returning to Key West on May 28. Meanwhile, Commodore Schley remained off Cienfuegos from the 22d to the 24th, and then proceeding eastward executed some complicated manœuvres off Santiago, ultimately approaching the harbor on the 29th and at length sighting the Spanish squadron inside.* Admiral Sampson arrived on June 1, and, the Oregon having previously completed her fine voyage, the battle fleet of the United States was now massed off Santiago.

The naval situation between May 16, when the Spaniards left Curaçoa, and June 1, when the close blockade of Santiago was established, is extremely interesting and instructive. If Cervera had made for Cienfuegos, he would have encountered the Flying Squadron. If he had steamed for Havana by the Yucatan Passage, he would have arrived without meeting any serious opposition, and the later proceedings would have been widely different. Cervera, however, short of coal and painfully conscious of the grave defects of his force, simply sought the nearest Cuban harbor. His entry into Santiago was at once reported; but nine days elapsed before any hostile squadron approached within 30 miles of the port, and on May 28, Commodore Schley reported, "Much to be regretted, cannot obey orders of Department. Have striven earnestly; forced to proceed for coal to Key West." At Santiago, on the other hand, there were 3500 tons of coal,† and although appliances for putting it on board were deficient, a more energetic people than the Spaniards would doubtless have found means of filling the bunkers of the cruisers and getting them to sea several days before the United States Navy was in a position to blockade. The dominating influence of coal-supply upon naval operations received a striking illustration.

Another point is well worth notice. In times of peace we are wont to assign strategic importance to various positions in ac-

* Admiral Sampson seems never to have doubted the information that the Spanish squadron was at Santiago.

† Lieut. Müller y Tejeiro.

cordance with academic considerations. In naval war, the position of supreme importance is that of the enemy's fleet. Thus Santiago, previously unconsidered, became on May 19 the *crux* of the naval and military situation, and such was the irony of events that Cervera's movement from Cape Verde Islands, which had caused panic on the Atlantic seaboard, turned absolutely to the advantage of the United States.

Much has been written about the difficulties of modern blockades, and doubtless with a view to mitigate the harassing strain upon the fleet, Admiral Sampson on May 27 * determined to obstruct the channel leading into Santiago harbor. On the night of June 3, the attempt was made by Naval Constructor Hobson and seven volunteers. It was a gallant act, worthy to rank with the highest deeds recorded in naval history; but the failure to sink the Merrimac in the fair-way was most fortunate. If the Spanish squadron had been imprisoned, its whole resources, like those of the Russian Black Sea fleet in 1854, would have been available for the land defense, and the subsequent difficulties of the military expedition would have been immensely aggravated. The Merrimac plan conflicted with the teaching of naval history and its failure was an unqualified gain.

The navy having established its blockade, it was necessary, as in all such cases, for the army to act, and Admiral Sampson at once asked for 10,000 men to take the works commanding the entrance to the harbor. The expedition was to have embarked on June 8, when a rumor arrived that an armored cruiser had been sighted by the Eagle off the north coast of Cuba. Admiral Sampson "placed no confidence whatever in this information"; but a delay of several days, which he justly characterized as "most unfortunate," was entailed, and the incident is vastly significant. Reluctance to send a military expedition to sea, when a possibility of encountering an enemy's ships existed, was always manifested in sailing days and is now far more than ever justified. A most improbable rumor has, however, rarely proved so potent as in this case. While the expedition was being held back, Admiral Sampson, strictly following the precedent of 1741, occupied Guantanamo Bay and landed a battalion of marines. Few harbors could be more easy to blockade than Santiago, where the

* On this day the New Orleans was ordered to Santiago with the collier Sterling, which was to be used for this purpose.

channel of exit is narrow and tortuous while the coast batteries were wretchedly made and the gunners hopelessly incompetent. Yet, as Captain F. E. Chadwick shows,* the possession of a neighboring harbor was almost absolutely essential for the work which had to be carried out by the powerful American fleet. A finer body of troops than the 13,000 regulars who formed the bulk of the expedition has rarely landed on a hostile shore; but, like the British force which invaded the Crimea in September, 1854, it was an aggregate of brave men rather than an army. Admiral Sampson's plan, which offered few difficulties, was now unaccountably abandoned, and while the military commander-in-chief remained on board ship, his troops moved inland to the attack of the town of Santiago. Transport, adequate artillery, and organization were alike wanting. From the technical point of view, the severe fighting of July 1, like the battle of Inkerman, invites facile criticism. The storming of the positions of El Caney and San Juan, however, showed the qualities of the American infantry in the brightest light, and as has frequently happened in the history of the Anglo-Saxon peoples, conspicuous personal gallantry triumphed amidst difficulties which might have involved disaster. But the cost was heavy and, exhausted after their great efforts, the troops could only entrench themselves in the positions occupied. The intention to assault the town at daybreak on July 2 was, therefore, abandoned and a momentary wave of depression passed over the United States. At Havana, however, the crisis was considered to have arrived and Admiral Cervera, whom the Spanish government with inexcusable folly had placed under the order of the military commander, was directed by telegraph to go to sea within twelve hours. Good gunnery—the best defense of a ship as Farragut insisted—and high speed could alone provide a chance of escape. The Spanish squadron was deficient in both, and within four hours it met with the "total destruction" which its admiral had anticipated. The running fight of July 3 strongly resembles that of Sir John Duckworth with the squadron of Admiral Leissègnes off San Domingo on February 6, 1806, when two French ships of the line were driven ashore and three captured; but modern conditions hastened and gave a tragic completeness to the issue.

* *Scribner's Magazine*, Nov., 1898.

The minor technical lessons of the action have been frequently pointed out; but the most striking feature was the intense eagerness displayed by all the American captains to bring their ships into action. Here was the true naval instinct which was conferred victory in far more serious contests. The performance of the Oregon is remarkable as showing clearly the effect of the experience and training of the engine-room staff gained in the long voyage from the Pacific.

The navy had brilliantly discharged its task; but the land operations were involved in difficulties daily increasing, and General Shafter telegraphed that "it will be impossible to carry" Santiago "by storm with my present force." That front attacks on prepared positions are precarious, especially when unsupported by a powerful artillery, was abundantly proved during the Civil War before the era of the magazine rifle. This may perhaps have been forgotten and the want of transport and camp equipment seems to suggest that an easy success was anticipated. The troops were now beginning to suffer severely from exposure and insufficient supplies. The experience of the Crimea was repeated on a smaller scale, and in face of an interprising and energetic enemy, the situation would have been serious. The Spaniards, however, remained true to their traditions of not attacking, and were evidently unaware of the critical state of their opponents. The conditions of 1741 were thus almost exactly reproduced, and, to complete the parallel, a marked divergence of naval and military opinion asserted itself. Already, on July 2, Major-General Shafter had urged the admiral to force an entrance into the harbor.

I urge that you make effort immediately to force the entrance in order to avoid future losses among my men, which are already very heavy. You can operate with less loss of life than I can.

The admiral, however, held steadfastly to his original plan and replied at once:

Impossible to force entrance until we can clear channel of mines, a work of some time after forts are taken possession of by your troops.

In a letter of the same date, the admiral dealt with the question in more detail and clearly explained the position. At the same time, he expressed his absolute willingness to cooperate as far as naval considerations permitted.

If it is your earnest desire that we should force our entrance, I will at once prepare to undertake it. I think, however, that our position and yours would be made more difficult if, as is possible, we fail in the attempt.

After the destruction of the Spanish fleet, pressure seems to have been brought to bear at Washington, and the Secretary of the Navy telegraphed as follows on July 13:

The Commanding General of the Army urges and Secretary of War urgently requests, that Navy force harbor; confer with Commander of Army. Wishing to do all that is reasonably possible to ensure the surrender of the enemy, I leave the matter to your discretion, except that the United States armored vessels must not be risked.

Such differences of view are common in the history of war. Admiral Vernon and General Wentworth had a somewhat violent altercation before Santiago in 1741. Nelson, in the Mediterranean, was obliged to point out to British generals that the powers of ships had limitations. On the other hand, our greatest admiral proposed in 1795 an Austrian occupation of San Remo in circumstances which to most thoughtful soldiers appear prohibitive. Napoleon, who had no time to study naval war, frequently demanded impossibilities of his fleets, and ordered the Allies out of Cadiz to meet destruction at Nelson's hands, precisely as Marshal Blanco dictated to Admiral Cervera, a movement which the latter rightly judged to be hopeless. Wellington in the Peninsula complained bitterly of the want of naval cooperation, ignoring elementary naval considerations as completely as his great antagonist. In 1870, it seems to have been expected that the French northern squadron could effectively attack the Prussian Baltic coast-line, and instances of this kind might be indefinitely multiplied. Officers of the naval and military service are trained in different schools of thought. Neither class can perfectly understand the functions of the other, and military men are peculiarly prone to ignore naval conditions. The United States naval officers had evidently a much clearer conception of the powers and the limitations of naval cooperation than their military comrades. The battle of the Nile is, for all time, an object-lesson of the danger of sacrificing naval considerations to those of military expediency. In free countries, therefore, it may fall to politicians, ignorant of naval and military affairs alike, to adjudicate between the conflicting views of the services. This was fortunately unnecessary in the case

of Santiago. On July 11, General Miles arrived and at once proposed to land forces to take the harbor forts; but negotiations were already in progress, and on the 17th Santiago, which had twice defied a British force, surrendered to the United States. In view of the painful position of the gallant troops entrenched before the town, the fall of Santiago was a welcome release from anxiety. The Spaniards might certainly have prolonged their resistance for a short time; but the moral effect of the military surrender following two great naval disasters told heavily at Madrid. Although General Miles with a force of volunteers began his admirably-managed operations in Puerto Rico, the end of the war was at hand, and Santiago, thanks to the squadron of Cervera, proved the decisive point.

Technical lessons are generally far more easily learned and more surely applied than great principles. That inflammable woodwork creates grave danger on board a ship in action we fully recognize. The want of fresh water was most seriously felt by the United States ships * some of which were crippled on this account. "Make up" water must either be carried in the double bottoms of vessels required to keep the sea for a long time, or distilling ships must accompany a fleet. The predilection of the United States for monitors, arising out of the peculiar conditions of the Civil War, will be mitigated now that these craft have proved absolutely unsuited for work at sea. Seagoing and sea-keeping qualities are unquestionably of the first importance in war. Torpedo-boats, in spite of "careful nursing," † at Guantanamo speedily broke down in carrying on the duties of the blockade of Santiago, and their limitations will be duly noted. If, however, they were previously used in some cases for towing coal barges at Key West, the breakdown is partly explained. In their proper *rôle* they were not tried; but it is permissible to believe that men as gallant as the crew of the Merrimac would not—if the opportunity had been given to them—have taken torpedo-boats into Santiago harbor with effect.

The disparity of naval conditions arising from the incompetent administration, the political weakness and the poverty of resources of Spain deprived the war of 1898 of the teaching which

* But for difficulties thus arising, the Iowa would have been well to the fore in the chase of the Colon.

† Captain F. E. Chadwick, U. S. N.

might otherwise have been forthcoming. The Spanish Navy was as ill-prepared for a campaign as the French Army in 1870. Thus many of the questions which of late have been eagerly discussed received no elucidation. We may say with certainty that rapid and accurate fire is now, as in old days, the decisive factor in naval warfare. It is significant that a single shell from the armed liner St. Paul put the destroyer Terror out of action at about ten times the effective range of her torpedoes, while the four 6-pounders and four 3-pounders of the yacht Gloucester sufficed to complete the total destruction of the Furor and Pluton.* It is clear that the three destroyers proved a heavy incubus to Cervera's squadron in its passage from St. Vincent. The use of the destroyer, however, is solely in the attack and we have yet to see whether its offensive power will compensate for fragility, and whether it can claim a wider sphere of action than the hunting of the torpedo-boat.

The grave mistake of placing transports under military authority will hardly be repeated. The supervision of the large number of mercantile steamers which were employed to convey the expeditionary force to Cuba was not the business of soldiers, and many evils would have been avoided by entrusting it to naval officers as is the practice in Great Britain. The proper functions of the soldier end at the shore-line, and when he is permitted, as in 1898, to lay his mines in navigation channels and to flash searchlights at his sweet will, he becomes a public danger. There are special cases in which submarine mines in army hands may be justified; but such cases, in the harbors of great maritime nations like the United States and Great Britain, are exceedingly rare. The mines laid at New York and elsewhere proved an unmitigated nuisance, as might have been confidently expected.

One other lesson may be learned with advantage. The modern craze for coaling stations needs to be abated. The proceedings of the United States Navy in 1898 have clearly shown us that the superior fleet can largely dispense with these luxuries. Guantanamo harbor served its purpose quite as well as if it had been an expensively fortified port in the hands of the United States. Now, as in the old sailing days, bases can generally be extemporized in accordance with requirements. It is upon the effective

* These two destroyers, however, undoubtedly received punishment from the secondary armaments of some of the heavy ships.

management of colliers rather than upon coaling stations that a great naval power will depend in war.

The great principles which the war of 1898 exemplified are old: but they have been frequently forgotten in the past. That the intermixture of politics with naval and military affairs is invariably detrimental and may be disastrous, history has plainly shown. Popular fears and popular fallacies must not be permitted to influence the conduct of warlike operations. Success in war by sea and land is obtained by sea-going and sea-keeping ships, and by organized field forces. The various adjuncts which usurp attention in peace time are of relatively small account. A maritime nation possessed of a large shipping can now as formerly supplement its fleet by vessels which for certain purposes are very valuable; but an expeditionary force with all its manifold requirements is not easily improvised even when the best material is available. Nor can the greatest energy on the outbreak of war atone for want of an organization which is essentially the product of careful study in time of peace. In regard to coast defense, the rich experience of the past has been strikingly reaffirmed. San Juan and Santiago, like Alexandria in 1882, and a hundred other cases, show that ships cannot seriously injure guns on shore. Now, as always, ports containing essential naval resources, or required for the protection of a commercial marine, require defense against naval raids; but the real protection of a coast-line must continue to depend on the mobile navy. The sum which a nation can spare for naval and military purposes is practically limited, and all superfluous expenditure upon coast defense entails loss upon the sea-going fleet and the field army which are the real arbiters of war. This ancient lesson has not yet been wholly assimilated in England where, in recent years, we have seen the fleet starved at a time when superfluous fixed defenses were being liberally created. Americans who have marked the vigor and the initiation, the skill and the daring displayed by their navy in the recent war, cannot fail to understand where lies the true defense of their coast-line.

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COMBINED MARITIME OPERATIONS.*

By CAPTAIN ASA WALKER, U. S. Navy.

All hostile operations between countries separated by waters, other than rivers, must partake, in a greater or less degree, of the nature of "combined maritime expeditions," and have at their inception, for consideration, the immense problem of convoy.

The subject of convoy is so important and of such scope that in itself it constitutes a broad field for individual labor, and should be treated apart from that of combined operations, since, in truth, but one branch of the service is in position to attack or defend. The military part of a convoy being worse than helpless, all operations must be purely naval.

Leaving, therefore, this subject of convoy to the pen of others, we shall endeavor to discuss briefly the object and scope of combined maritime expeditions, and to demonstrate when and how success may be expected.

Whenever land and naval forces combine in any operations it is to be taken for granted that the component parts will work loyally and well for the accomplishment of the end in view, each within his own sphere of action. The general and the admiral, the officer and the private must sink the individual and look only to the success of the plan given to them to carry to a happy issue.

It is hardly to be presumed, in this day of heavily armed and swift ships, that in a war between two great powers, either would dare to despatch across the water an army of *invasion*, without having previously forwarded a more mobile force to seize and hold a base for its landing. A force of moderate size, to seize,

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fortify, and hold a place for disembarkment would necessarily be more compact and mobile than one of the same size intended for campaign work, since many serious questions would be eliminated, as this force must be considered, for the time, as being on garrison duty.

We may, therefore, consider our problem to be how best to seize and hold, with a moderately large combined force, a position on the enemy's coast, at which, when secured, the main expeditionary forces may safely land; or, in other words, to establish a fortified base. That even this primary occupation may be a success presupposes a local superiority in the fleet which must accompany the immense convoy, of which this force is but the advance guard.

While the facilities for maneuvering ships increase from year to year, and the appliances for handling troops grow more and more perfect, yet it is quite impossible to eliminate the element of time from military and naval operations. The arrival of a hostile fleet on a coast, though it be at a point farthest from the centers of population, will be heralded to the whole land before the hulls of the vessels are above the horizon. The nation's forces will thus be told where their enemy is to be found. The hostile fleet must do quick work with its disembarkation and be ready to repulse an active enemy.

The question of command and control in a combined military and naval expedition is one of such vital importance, that upon its disposition depends absolutely the success or failure of the expedition. Educated from their youth up to perform the duties of their profession, on land or on sea, the military and naval officers must be looked upon as experts in their professions. Each must be considered competent in all the duties which may fall to him, in his own sphere. From the very nature of the services, it would seem that a natural boundary line existed, so clear and plain that conflict should be impossible.

As the whole character of a combined expedition is a military one, its conduct, during its various steps, must be under the control of those most experienced in the different stages of its progress. The officers whose lives have been passed on board ship, at sea and in port, would, unquestionably, be better capable of managing the questions of lading, discipline, navigation, and tactics as applied to sea maneuvering, than those of the army

branch, whose regular duties are so different. Those who have had to do with military drills, equipments, ordnance supplies, commissary stores, and all the vast multitude of details pertaining to operations of war on shore, should be expected to have entire charge of such matters. From shore to shore should be the sphere of the naval officer, and there his authority should end.

Each transport to carry troops or supplies should be in command of a naval officer, and to him should be intrusted her lading and her discharge; with him should rest the responsibility for her navigation, her proper position in convoy, her efficiency, health, and cleanliness. This is, in effect, the practice in countries, which, in the past, have despatched combined expeditions. The officers of the troops embarked must have complete control over their own men, subject to the general regulations of the ship as to matters of safety, health, and comfort. This naval command afloat is the more essential, as no convoy can expect to cross the seas unattacked, and the commanding officer of each unit therein should be able to maneuver under signal, to avoid confusion in the hour of danger.

That any military expedition may be a success demands the utmost thought and care in the preparation of its details. The character of the troops, their discipline, the proper proportion of the various branches of the army, their supplies of all sorts, and the thousand and one matters, great or small, which militate for the good of the soldier, each and all demand attention. In the case of troops acting in their own territory, such care and forethought is eminently necessary, but its neglect in minor matters would not be so vital, since the possibility of the rectification of mistakes remains. An army with open communications to its base might be expected, in the course of time, to remedy all errors made at its inception. Such is not the case with a combined force; *it* must sail with its outfit complete and work out its own salvation from its condition on leaving port. Hence it is necessary, nay vital, that every energy of those having the outfitting in charge should be strained to the utmost, that all proper equipments should be provided and of ready access to those charged with their stowage and conveyance.

A few hours, or even days, spent in the careful consideration of plans for the stowage of men and material will vastly simplify matters when those men and that material are wanted for service.

Detailed plans of each ship should be made, showing just how many men of any particular branch of the service she can carry, together with all equipments and supplies necessary to make that detachment of troops complete in all respects for service. In other words, if a body of troops be assigned to any ship, that ship should have on board, stowed readily at hand or in proper order, all the outfit, of *every kind*, requisite to the equipment of that unit of force, ready for active service.

Military authorities have investigated the question of the movement of troops and war supplies by transport, and have laid down certain general rules as to the space required for men, horses, and mules. These rules must be more or less flexible, though in general they may be accepted as bases whereby the general plan of an embarkation may be predicated—exceptions may arise with exceptional ships. The rules for space and tonnage given by Captain Goodrich, of our service, are: For men, 52 cubic feet and from 3 to 4 tons; for horses, 126 cubic feet and from 8 to 10 tons.

In making the detail for embarkation, consideration should be had for the character of the troops detailed for each vessel. Ships which would comfortably carry infantry may be entirely unfit to load cavalry, since the latter require a much higher between-decks than the former. In general, vessels for the transportation of horses and mules should have from 10 to 12 feet of headroom for proper stowage.

In the inspection of ships for transport purposes, many points are to be considered other than those pertaining to actual seaworthiness. The comfort and health of the living cargo is of vital importance, and hence every available means must be adopted to have the living quarters clean, dry, and well ventilated. To this end, ventilating fans should be installed, conduits run to all parts of the living space, particularly to those more remote from the hatchways, and ventilators extending well above the upper deck, built. The exhaust system would thus insure a sufficiency of good air, even with the hatches battened down. A full cargo of mules and horses was recently lost, every animal being asphyxiated because of the battening down of the hatches during a typhoon.

The inspecting officer would naturally give his careful attention to each and every item that constitutes the equipment of

well-found ship, and should, when practicable, determine the metacentric height under various conditions of lading. Anchors, chains, sounding gear, charts, nautical instruments, capstans, windlasses, steering gear, and all other devices of navigation should be carefully overhauled and put in perfect order. The engines and boilers must be rigidly tested and proved to be without flaw. Hemp and wire hawsers should be stowed where available at the shortest notice, either for towing or taking in tow. Fire pumps and hose should be tested and proved efficient, and a fire bill made out for the *regular crew*, with provision for assistance from the military passengers. Boats, life rafts, and life-preservers must receive the most careful attention in all their parts, and be made ready for immediate use. Bulkheads should be most rigidly inspected and strengthened, if indicating weakness. All valves should be overhauled and made to work freely and well. If practicable, each ship should be docked, so that the underwater body might receive the same attention as the top sides; especially should all the openings through the bottom be examined for local deterioration. The flushing system of the ship should be put in perfect order, that a copious supply of water may be delivered to the water-closets, of which there should be a liberal number, properly located. The berths for the troops should be arranged so that they may be readily unshipped and removed, to allow a thorough cleaning of the sleeping quarters; the decks of these quarters should be well covered with shellac throughout, to insure dryness.

Accommodations for a fixed number of troops having been made on board a transport, the equipments and supplies complete for them should be tallied with the ship's name, letter, or number, and assembled at her place of lading. The officer in command must receive and stow these articles in such order that all may be, in a degree, available in a brief space of time. Too much stress cannot be laid on the importance of having stowed on board of each transport every article which goes to make up a perfect equipment for the personnel therein contained. Instances are on record where vitally necessary stores have been so stowed as to be unavailable for days. Various parts of gun mounts have been embarked in different ships—wheels in one, axles in another, etc.—so that the utmost confusion resulted when it became necessary to assemble them, and the battery, for the time being, was helpless and useless.

All stores, supplies, and equipments should be received on board and stowed before the troops are admitted to the ship, and this work should be done by the ship's company, or by stevedores under the direction of the ship's officers.

When about to embark the troops, the officers of each company should individually be shown the exact location of their company quarters and the shortest and least obstructed passage thereto, and should be instructed where to form when arriving on board. The racks for arms and equipments should also be designated for each unit of the force.

The question of messing the troops will depend largely on the interior arrangements of the ships, and must be met by each one according to circumstances.

The boats with which a ship is provided are intended for the general service of the ship, and for the rescue of the crew and passengers in case of disaster. They should have sufficient capacity to contain all the people who may be embarked in the ship, together with a moderate amount of provisions and water. When, however, there is a question of disembarking troops, with their proper equipments, in a ship's boats, it is found that but few can be accommodated, save in those of the largest size. No ship's boat is suitable for the transportation of horses or artillery. It has long been the aim of the military authorities to devise some practicable craft for landing troops and supplies, one which could be transported with the troops and put into immediate use on the arrival at the place of disembarkment. Many models have been suggested, many have been tried, yet, thus far, not one has shown itself the perfect article from all points of view. It is not difficult to construct a float, pontoon, or scow which would answer perfectly, but when it is constructed the question will arise how to get it to the scene of operations. If it be stowed on the side of the transport it is liable to be destroyed by the sea, should heavy weather come on; if carried on deck, it occupies too much of the deck space, every inch of which is necessary to the health and comfort of the living freight; towing will be out of the question. Connected with every combined fleet there must be a proportion of vessels exclusively employed as freight boats, in the capacity of colliers and supply ships. To these may be relegated the duty of conveying the scows for landing the troops and munitions. Each collier or supply boat could readily carry

on her upper deck, on properly constructed beds, four or more scows of sufficient capacity to lighter troops of all arms of the service, with the requisite supplies. Fitted as they would be with cargo booms, these ships could handle the scows with perfect ease. Each transport should have a steam launch of sufficient power to handle one or more loaded scows in weather, such as would be necessitated for landing. Crews for the scows should be furnished from the personnel of the transports and supply ships.

In the present day, when the civilized nations of the world have made elaborate charts of their own coasts, and have sent forth expeditions to survey and chart the coasts of less civilized peoples, there remains less for the commanding officer of a combined expedition to decide than in remote periods. The hydrography and topography of coasts are so well delineated on charts that an engineer, in his study, can determine almost absolutely at what point or points an expedition would find conditions suitable for a landing, and surroundings capable of occupation as a fortified base. This problem would no longer be left to chance, or to the judgment of the expeditionary commander. While it would be necessary to leave such commander a certain amount of latitude in his operations, his instructions would be such as to confine those operations to places selected by the council in charge of the war. In his instructions would be found complete details of the natural features of the places favorable for securing the object of the attack, together with the consideration of the harbor facilities, sanitary conditions and local supplies.

Considering the power of modern ordnance and the range of the small arms of to-day, it would seem hopeless for a combined expedition to force a landing where strongly opposed. A few well-placed and well-served heavy guns on shore can withstand successfully many times their number afloat. Fleets cannot silence and destroy forts. Troops cannot land in the face of earthworks and fortifications well manned; landings must, therefore, be made at points where no fortifications, or but slight ones, exist. Infantry opposition to a landing has become a more serious matter than in former days, the increased range of the rifle permitting effective work at much greater distances, demanding a heavier and more extended sweeping by gun-fire of the environs of the proposed point of disembarkment.

[illegible] it is necessary to consider the general con- [illegible] of the coast [illegible] landing. The concave or deeply [illegible] are more unfavorable and dangerous [illegible] and the point or peninsula [illegible] the strength formerly attached to it. [illegible] must be feared than [illegible] It is possible that a long, shel- [illegible] advantages [illegible] be ex- [illegible] The extreme [illegible] attack at points widely [illegible] near in time. The [illegible] though dependent [illegible] attack at points so distant from each other [illegible] were completely exhausted in the [illegible] the real effort was made [illegible] and Blake's troops were [illegible]

[illegible] attacks on Louisburg in the last century the [illegible] employed and in both cases with an eminent degree of success. With such illustrations from the past, when the motive power of the transports was the wind, and that of the boat, wind and human muscle combined, it would seem that the present facilities of locomotion on the water would warrant us in the expectation of being able to deliver attack at will on coasts, [illegible] well defended by land forces unintrenched.

In approaching a coast for the purpose of landing, most careful and thorough reconnaissance must be made. The smaller vessels of the fleet, with proper representations of the general staff of both army and navy on board, should make a thorough examination of the whole littoral, to determine what points, if any, are held in force, what fortifications exist, where the beach presents the most favorable conditions of approach, and make sure that the landing is made under the most favorable circumstances. Here, too, it would seem, a captive balloon could be used to good effect.

A landing in force on a wooded beach should be made only after a most careful examination from the water, followed by the exploration of scouts landed at several points. These scouts would force the enemy to show himself and unmask his position [illegible]. The vessels of light draft should be able to support these, and to assist them if hard pressed.

An unopposed landing presents few difficulties, and should be accomplished by a well-organized expedition in quick time and in perfect order. The headquarters for the various units of the corps should be marked by flags placed in conspicuous positions, and the transports conveying those units, of all arms, should be brought as near the headquarters flags as possible. Companies should fall in at the instant of landing and take their proper places in regimental formation. Regiments should at once proceed to brigade headquarters and assume position assigned. Each officer should clearly understand the part that his body of troops is to perform, and its place in the grand whole. At this time will be recognized the supreme advantage of having placed on board each transport the complete equipments of the force thereon embarked. Each transport will land its living freight, armed cap-a-pie, ready for immediate service.

With the troops once disembarked the landing of supplies becomes a matter of detail, dependent largely on the operations of the force landed. As the intentions of the force were, primarily, to establish a fortified base, these supplies would consist chiefly of material for that purpose, and would not include, to any great extent, the material for transportation, and the vast trains of supplies necessary for long marches in an enemy's country. So long as the army could keep in touch with the fleet, the bulk of the supplies would find ready transport by water. It goes without saying that the first objective of the expedition would be the seizure of some harbor or sound, in which its fleets could anchor and be protected from the weather, and where its forces could entrench themselves and protect the approaches. To this end the landing must be made not far from such harbor or sound. The details of all land operations belong to the military branch of the expedition and must be carried out by it, the assistance of the naval force being given wherever practicable.

When the landing is opposed, the commander-in-chief must be governed by circumstances as to the point of disembarking the troops. He must determine in what positions the enemy is in strongest force and select the least exposed route for his boats and the place at which the forces can most readily establish themselves. In this case it would seem imperative that feints should be made at widely distant points, to confuse and divide the enemy's forces. The entire extent of shore at the place of landing

must be kept under the guns of the convoying fleet, the smaller vessels as near to the beach as the water will permit. The rapid-fire batteries of these war vessels should be able to break up any heavy attack on the landing forces.

The intelligence bureaus of all the powers, in recent years, have devoted so much attention to the affairs of their neighbors that the littoral of every foreign country is almost as well known as that of their own land. Each railroad, wagon road, and even footpath is on the war chart; telegraph and telephone lines are delineated; churches, farm houses, and barns are cut in with the utmost care; each hill, woodland, meadow, and swamp is designated in detail. Hence, a general, landing or proposing to land on a hostile coast, would have all necessary material for formulating a plan of immediate campaign; the necessity for extended reconnaissances in an unknown country no longer existing, he could assign his various units of force at once to their stations.

History furnishes but few examples where combined expeditions have been landed when seriously opposed. In most cases the winds and sea—surf—have offered the greatest resistance, and to them may be attributed the main loss. General Abercrombie's landing at Aboukir Bay, in 1801, appears to be the sole combined expedition, in force, given us in modern times, where serious opposition was met with and successfully overcome. This success seems to have been due to overconfidence on the part of the French, who had plenty of time to reinforce their forces and strengthen their works to such an extent as to render the landing impossible. As it was, 2000 men were left to protect 3 miles of beach against the 6000 forming the first landing party. The list of killed and wounded attests the bravery of the defense, as well as the gallantry of the attack.

Admiral Colomb, R. N., in his forcible paper on "Combined Military and Naval Operations," has entered into details with reference to the most important of such operations of modern date, and has clearly shown the sphere of each branch of the service therein. He points out how unfitted either is, alone, for the accomplishment of any permanent conquest. He says: "In every case, the navy was but the handmaid of the army, as far as attack went," and again, "The function of the naval force is to guard the communications over sea and to take care that no interference with the operations of the land forces is offered from the sea."

It would seem to be the general opinion of good authorities on the subject, that when the naval portion of the expedition has convoyed the transports in safety to a landing, has successfully assisted at that landing, has afforded protection to the wing of the army within range of its guns, and has established an efficient blockade, to prevent annoyance from enemy's vessels and the introduction of supplies from the sea, its rôle becomes a passive one, subordinate, in all shore operations, to that of the army.

If, in violation of precedent, a landing be made in the face of strongly posted troops or fortifications, it must be regarded in the light of a forlorn hope. All the chances are against success and attempt is but courting disaster. Modern armaments serve to accentuate this fact, since the range of death-dealing weapons has been so wonderfully increased. The landing of vast bodies of men and horses, with the artillery and stores, even under the most favorable circumstances and with the most perfect organization, presents great difficulties. If, then, we complicate these difficulties by subjecting the troops to the fire of a determined enemy, begun at long range and continued during the confusion attendant on disembarking, what but pre-eminent disaster can be the result? Under no circumstances can the result of a battle be absolutely certain until the fight has been made; yet no general, of his free will, will begin an action unless he believes he has at least an even chance of success.

In the case under consideration, everything is against the attacking force, and entire discomfiture only can be expected. Undoubtedly, the character of the enemy must be considered, though the old maxim, not to despise one's enemy, should be kept in mind. The English had cause to rue the neglect of this principle in the attack on Taku forts in 1859, where so much intrepid heroism was displayed and whence comes the heart-stirring phrase, " Blood is thicker than water."

If, in attempting to land in the face of an enemy, his fire is found too heavy while yet the troops are in the boats, the retreat may be made, possibly in good order, but doubtless with serious loss; but should the troops have been landed before the enemy's strength has developed, then retreat becomes a far more serious matter—the troops must be embarked in the presence of an active enemy. All defense now depends on the fire of the warships, and

its efficiency upon the nature of the ground. If the ground be flat, then the embarking troops mask the fire of their warships and prevent aid to themselves; if it be high, sloping toward the beach, it may be possible for the ship gun-fire to hold the enemy in check while the embarkation is proceeding. Under the best circumstances, the loss in men and material must be immense. History furnishes few instances, in modern times, where troops have embarked under fire, and these few give warning of its extreme peril.

In closing this most imperfect and brief consideration of an important subject, it seems pertinent to dwell for a moment on the points which appear to be demanded to conduct to a successful issue. It will suffice to name them, as each has been mentioned and treated within. Transports *must* be absolutely under naval control; they must be loaded and discharged by the navy; organization on board must be effected and maintained on a naval basis; the embarkation and disembarkation of troops should be practiced, as a drill, during the period of outfitting; each transport should carry a complete outfit, in every particular, for the troops conveyed by it, and should have its stores so stowed that each class may be available for immediate issue.

In the recent landing of our forces on the coast of Cuba the entire neglect of the above-enunciated principles caused all of the troubles and vexations met with. Had the transports been in charge of naval officers, trained in obedience to the orders of their senior officers, there would have been no seeking for a transport five or more miles at sea; each one would have been in its assigned position. The excellent work done by Captain Goodrich, as the naval officer in charge of landing, reflects the highest honor on him and on the service he ornaments, yet, what might have been the tale of men landed had the organization and control been such as above designated. With the facilities at his command he accomplished wonders; his arrangement of them was practically perfect, but his difficulties were so numerous and unavoidable that the results, though grand, were reduced to a minimum.

It is to be hoped that " experientia docet " will become a truth in any future combined operations in which this country may be engaged, and that our sister branch of the service may join with us in relegating " the shoemaker to his last." It were foolishness

for the navy to desire control of operations on shore, and, unquestionably, it is equally unwise for those lacking all marine training to invade the territory of the sea. The field is broad enough for both. Let us, then, unite and let our army brothers say to us, "Land us in position to do our work, protect our sea flank, keep open our communications, convoy our supply fleets, and see that we are furnished with the sinews of war, and we will do the rest."

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE ST. LOUIS' CABLE-CUTTING.

By CAPTAIN CASPAR F. GOODRICH, U. S. Navy.

The U. S. S. St. Louis left New York on the 30th of April, 1898, to scout off the island of Guadeloupe in the hope of sighting Cervera's fleet. While engaged in this duty, many conversations were held by her officers as to what the ship might do during the war, which would be useful to the country, and as to the various means by which our own cause could be advanced or the enemy's injured. Some one, I have forgotten now who it was, remarked that Admiral Sampson would greatly appreciate the cutting of the submarine cables leading to Cuba and Porto Rico, adding that a cable ship was now a necessary part of any well-organized fleet.

"Not at all," said Chief Officer Segrave, "there is nothing easier than to pick up and cut a cable."

At this the rest of us exclaimed, "How is it done? Can you do it?"

Mr. Segrave replied: "All you have to do is to lower a stout grapnel to the bottom and to drag it slowly across the location of the cable. If the bottom is sandy and free from rocks you can often catch the cable on the first drive. If, on the other hand, the bottom is foul, you may spend a week and not get it even when you have special appliances for the purpose."

"How do you happen to know so much on the subject?"

"I have spent years laying and repairing cables. I have, myself, laid some of the cables now in the West Indies."

"Could you pick up cables in so large a ship as the St. Louis?"

"Why not? It is only a question of devoting a big and valuable craft to work which might equally well be done by a small steamer."

"Would you like to try for those leading to Porto Rico?"

"Very much indeed."

We ran into Guadeloupe on May 11, and I immediately telegraphed to the Navy Department and to the commander-in-chief: "Unless I receive orders to the contrary, I shall destroy the two telegraph cables to San Juan, Porto Rico, which my first officer has laid [in] shallow, navigable waters." That evening, the ship proceeded to St. Thomas where instructions to join the admiral's flagship at a stated rendezvous off Cape Haytien and at a stated hour were given me. Orders *not* to destroy cables never came to me because they were never sent.

We learned at St. Thomas, in ways which it is not well to divulge, that the cable from San Juan to Jamaica was out of order. To isolate Porto Rico, therefore, it would be necessary to cut the St. Thomas San Juan line and the alternate lines leading out of Ponce to Jamaica and to St. Thomas. As time permitted, we decided to cut the first of these three lines on our way to the flag.

It is always surprising to find out how hard is the obtaining of any exact information on any given subject. We have all had this experience. Generalizations abound, but when one wants accurate knowledge every topic is seen to bristle with difficulties and to be shrouded in mystery. Cable-cutting is no exception to the rule. Now there are two important conditions essential to success in this operation: In the first place, you must know where the cable lies; and, in the second, how to pick it up. I think it may be broadly stated that, outside of the records of the proprietary cable company and excepting as to some shore ends, the precise location of every cable is unknown. No chart that I was able to obtain [illegible] intelligence, could tell me [illegible] for the purpose of raising the submarine [illegible]. True, there are many charts indicating [illegible] connecting various ports, but they are [illegible] a diagram closely in the [illegible] point sought would be a [illegible] consideration, however, which is [illegible]. Even the deep sea [illegible] shore ends are expensive. [illegible] upwards. It may therefore [illegible] the water is over 30 fathoms in [illegible] by heavy gales of wind,

the company will follow the shortest distance between the terminal points, which, in sweeping around an irregular and salient shore, will pass, naturally, from headland to headland. For example, when wishing to pick up the Santiago-Jamaica cables, we drew on the chart the straight course connecting the harbor mouth with Holland Bay, Jamaica, where the cables land, and we were confident that what we sought would be found, if at all, not far away. As a matter of fact we got the cables just where we reasoned that they must lie. But how much more satisfactory it is to know in advance where the cable was originally placed, and how fortunate I was to have at my disposal a man who had placed it there himself and knew how to go about grappling for it.

The process of grappling is very simple in the abstract. Over the *bow*, you lower a grapnel to the bottom and then steam very slowly ahead—barely moving the ship—square across the line of the cable. The grapnel creeps over the bottom, its prongs burrowing slightly under the surface of the soil until they catch underneath the cable. The gradually increasing tension on the grappling rope reveals to the expert, whose hand is always on the outboard part, that the cable is caught. The movements of the ship are under his control by signals to the bridge, and he measures the speed by the old device of the Dutchman's log—billets of wood thrown overboard from time to time. It is well to keep going ahead for a few minutes after getting an unmistakable "bite" in order to lift the cable off the bottom and thus ensure its being well hooked. Then the ship is stopped, the line taken to a steam capstan or winch and hove in. As soon as the bight is well out of water a hawser is bent to it and the grapnel relieved of its duty. When the cable is inboard a stout plank to protect the deck, a couple of sharp blows with an axe and the thing is done. Letting one end go and steaming a couple of miles away with the other make a gap of sufficient magnitude to embarrass the repair steamer, should she come along before peace is declared.

Practically much depends on the judgment and experience of the operator. He knows when it is best to put a shot of ¾-inch chain just ahead of the grapnel; when best to use manila; when ordinary wire is advisable. For deep sea work, in 1200 fathoms or upwards, a special steel rope has been developed, very strong, very light, very flexible, its outer strands wrapped with hemp

yarns. The "feel" is so much deadened that with improvised appliances you might catch and part a cable in such a depth of water and be never the wiser; or, you might miss it and think you had broken it. It is the old story—sooner or later in any particular branch of human activity we must abandon makeshifts, use standard appliances and call in the professional.

The conditions I have just described are those most commonly found—a comparatively smooth sandy or gravelly floor. For such conditions the outfit mentioned will suffice, with patience and care.

But cables often lie on rocky bottoms; possibly they run between boulders or coral heads that protect them from the searching prong of the grapnel which engages under one rock only to spring, when freed, clean and clear over the modest and retiring wire, or to have its prongs straightened out to a state of flabby uselessness. Here a cable is as safe as if buried in a trench except for the one chance out of the thousand which favors the grappler. Under these circumstances, recourse is had to one or more so-called centipedes. Imagine a piece of five- or six-inch lap-welded iron pipe, about three or four feet long. A series of square holes is cut in this pipe, each pair at opposite ends of a diameter, the diameters being placed spirally along the length of the pipe. Through each hole and its opposite, square pieces of iron or steel are driven and the ends turned forwards towards the ring by which the instrument is towed. This is a centipede It always has for its leader a length of chain. Two or more centipedes with their leaders are occasionally bent tandem to the same line. Perseverance and repeated trials are necessary even when centipedes abound. In cable practice it is sometimes considered economical to abandon altogether a leaky wire and to replace it with a new one rather than attempt to raise and repair it in such foul bottom.

While on this branch of the subject I may remark that the two cables from Santiago to Cienfuegos come under the head of cables protected by the nature of the bottom. We made altogether in the St. Louis and Suwanee no less than fourteen drives for them at points varying from just outside the harbor mouth at Santiago to ten miles distant but we never succeeded in getting the wire or in bringing up anything more than the grapnel itself with its prongs straightened out like the ribs of an inverted

umbrella. The Santiago-Cienfuegos cables were our conspicuous failure.

On the 13th of May the St. Louis broke the San Juan-St. Thomas cable. It was necessary to go quite close to the beach about eight miles east of San Juan—and great was the excitement created on shore by our approach. Horsemen could be seen riding frantically in all directions, doubtless to summon troops to resist or friends to facilitate an assumed landing on our part. Not being able to determine which was the actuating sentiment, friendship or enmity, we refrained from firing. The grapnel opened out in this drive, but it brought up enough of the gutta percha insulation and of the protecting hemp to justify us in believing that the cable was actually parted, corroborating the evidence of the heavy strain and sudden release of tension.

When, next morning early, I reported to Admiral Sampson, on board his flagship, both what I had done and what I thought I could do, he expressed his great satisfaction and he quickly adopted my suggestion that the St. Louis continue the work she had begun. Chief Officer Segrave was summoned over from the St. Louis that he might explain to the admiral his requirements in the matter of lines and grapnels. A number of Manila hawsers of 6, 7 and 8 in. circumference, and a lot of stout grapnels were delivered to us by the fleet. For inshore work, where light draught and handiness were necessary, the admiral was good enough to assign to my assistance the U. S. S. Wompatuck, commanded by an excellent, faithful and brave officer, Lieutenant Carl W. Jungen, U. S. Navy.

When such preparations were completed as the resources of the fleet permitted the St. Louis, displacing over 17,000 tons, the largest vessel, by the way, which ever wore a pennant, and her little consort, the Wompatuck, of 462 tons displacement, steamed away from the flag towards Santiago de Cuba, our first point of attack on the enemy's submarine communications with Cuba.

The following day, the 15th of May, was spent in the Windward Passage out of sight of land in fitting up the Wompatuck for grappling, furnishing her with steaming water, etc. It was determined that an attempt on the Santiago-Jamaica cables should be made by that vessel May 16, and we timed our movements so as to arrive off the port about 9 P. M.

The night was appropriate to the work, being moonless, but

clouds with mist and rain would have been still more acceptable as obscuring us from the enemy. Such as the weather was, however, the stars shining brilliantly in the calm air, we had no choice but to go in and run the risk of detection. Accordingly, a volunteer party from the St. Louis, with Chief Officer Segrave at its head, went on board the Wompatuck with me. They were not, as yet, formally enlisted or commissioned in the United States Navy, were in fact only under charter to the government by the American Line and thus lay under no positive obligation to endanger their lives in a military enterprise.

The Wompatuck approached the port from the westward, hugging the land and stealing slowly towards the Morro which soon towered above her. We were at the very mouth of the harbor. Lowering the grapnel quietly we soon had hold of a telegraph cable and then the heaving-in process began. In spite of our precautions, some noise must have been made, for a patrol boat came out towards us. Supposing that the Morro, which was close to us, mounted guns, and believing that our presence, now known, would bring a reinforcement sufficient to deprive us of the four or five hours necessary to grapple, raise and cut both Jamaica cables, I decided to abandon the attempt that night and try to reach my end in another way. We returned to the St. Louis, which lay in the offing, and learned that during our absence she had been chased by two patrol vessels flashing signals to each other. We then steamed well out of sight to the southward and westward.

On the 18th of May the St. Louis and Wompatuck came from the westward towards Santiago at daylight at the distance of a mile or so from the beach. At 5 A. M. we were within range of the batteries. The Morro fired a gun to give warning of our approach, and we supposed that it would be followed by a general opening of fire upon us. In this we were agreeably disappointed.

The water is so deep off Santiago that it was necessary to pass quite close to the batteries in order to reach bottom with our grapnel. When on a predetermined line of bearing from the lighthouse we lowered down not far from a thousand fathoms of hawser and began the slow work of feeling for the cable. It was not until after 11 A. M., if my memory serves me rightly, that the St. Louis hooked her fish and could heave in. In the meantime, great activity and excitement prevailed on shore.

Steamboats plied between the Morro and the city bringing troops and carrying away passengers whom we took to be women and children. At the Socapa battery and at that to the eastward of the Morro, men were working like beavers to get guns into position. It was evident that the Krupp 6-in. B. L. R.'s we had been told of as in place were not ready. Still no effort was made to disturb us, and I doubt whether, for a long time, the Spaniards suspected our object. At about noon, however, we had begun to lift the cable. Word to that effect must have been sent to the officer in command from the cable station, for the Spaniards opened on the ship—the lighthouse being then distant a mile and a tenth by observation. The shots were not well directed, however. We had no difficulty in shortly driving the gunners from their pieces near the Morro, or in seeing them as they ran away.* The Wompatuck, which had been lying well outside of the St. Louis, came up in great shape and joined in the action. The total broadside of the American ships in this fight was two 6-pounders on board the St. Louis and one 3-pounder on board the Wompatuck.

The battery of rifled mortars on Punta Gorda gave me much concern, for it was entirely out of reach of my little guns and yet was able to drop its shells all around us. We were practically a stationary target, for the St. Louis was fast to the cable. We could not make up our minds to let that go, so we stuck to it and hove it up. Once the bight was secured we could steam away as we liked. It was a great relief to me when the valuable and most vulnerable ship I commanded had put the western point of land between her and Punta Gorda. We were some forty odd minutes under fire—and exposed to large shells sent from guns beyond our range, whose accuracy of aim became painfully threatening. However, "all's well that ends well." We got the cable; we fought the Spaniards; and we silenced the guns that were within our range; and we escaped unhurt.

The next day we made an unsuccessful attempt to cut the French cable at Guantanamo, which we cut the day following,

* In the table of bombardments of Santiago given by Commander J——, Proceedings Naval Institute, March, 1899, p. 29, it is stated that a 16-cm. gun at the Morro " could only fire three shots." It appeared to us on board the St. Louis as if the cause lay rather with the gun's crew, which certainly, to a man, sprinted in fine form.

outside the Mole St. Nicholas. At this point the Wompatuck left us to join the flag at Key West.

The rough coral bottom off the south side of Porto Rico frustrated our subsequent efforts to isolate that island and demonstrated the need of special tools.

I have spoken already of my repeated failures to get the Santiago-Cienfuegos cable by which Havana communicated with Santiago. On two of these occasions we got at night close into the beach under the Socapa battery, once in the St. Louis, when there were but 12 fathoms of water under her bow, which lay just outside of the surf. Why the Spaniards did not blow the big liner out of water surpasses my comprehension. She offered an ideal target, her huge bulk plainly outlined as a silhouette against the background of a search-light beam behind her. Again, in the Suwanee, on June 16th, I got even closer still—so close that Lieut. Aranco of the Spanish Navy vainly begged the gunners to open fire on us, for he could both see and hear us distinctly. Probably Lt.-Comdr. Delehanty, who commanded the Suwanee, would have rejoiced in being fired at. For myself I frankly confess I am glad the Spanish commandant rejected Aranco's proposition.

About this time the Army Signal Corps was vainly endeavoring to get the remaining Santiago-Jamaica cable—the one which it seems the St. Louis had left intact on May 18, although I had reason at the time to believe it broken. The corps had chartered the cable steamer Adria, fully equipped for such work, while I had furnished all the information in my possession, had described how and where I had grappled number one, and what measures I should take to secure number two. As far as I could I aided in every way. Among other things I had strongly advised steaming across the line of the cable from east to west, for I had towed the broken ends of number one to the westward, leaving the eastern approach clear. Any cable picked up to the eastward would, therefore, in all probability, be a live cable.

Provided thus with all the counsel and knowledge at my disposal, the cable steamer, under the Signal Corps, made one last and dramatic effort—passing over the line with the Oregon and Texas between her and the batteries. To make a long story short she went from *west* to *east* and she did not get the cable then or at any other time.

On the night of June 18, the admiral allowed the St. Louis to try for the remaining cable. Starting in after nightfall and proceeding from *east* to *west* she picked up and severed the cable without difficulty or loss of time. From that date on no telegraphic messages passed out of Cuba via Santiago.*

The St. Louis cut the French cable from Guantanamo to Santiago on June 7, and the same day she grappled that from Guantanamo to Mole St. Nicholas. By the admiral's orders the latter was not cut, but about ten inches of the conductor were removed, and the injured place buoyed. The idea was to have this line only temporarily disabled and ready for subsequent use with but slight repairs. It is an interesting fact that for several hours afterwards, messages were sent and received over the damaged line. The moral is that if you want to stop the enemy's use of a cable you must completely sever it and separate the ends.

It was Chief Officer Segrave who put us in the way of cutting cables and who actually cut three, viz., San Juan-St. Thomas, the first Santiago-Jamaica, and the Guantanamo-Mole St. Nicholas lines. It was his temporary successor, Chief Officer Geo. E. Beckwith, who cut the two cables which formed the loop on the Santiago-Hayti section, leading into and out of Guantanamo—a most difficult job it was, too—and also the last Santiago-Jamaica link. They both bore commissions in the navy of the United States and well had they deserved them.

The St. Louis thus cut *every* foreign cable leading to Cuba and established an honorable name in connection with work which could hardly have been in the minds of her designers when they drew the plans of so noble a vessel, distinguished in war as well as peace.

It would be unfair if I brought this brief sketch of events to a close without recording my appreciation of the loyalty and pluck

* Marine Barracks, Navy Yard, Brooklyn, N. Y.,
November 15, 1898.

I certify that on August 10, 1898, I landed at the cable station at the entrance to Santiago Harbor, and had a conversation with the operator. During the conversation the operator informed me that no news had been received or sent over the Jamaica-Santiago cable since the 18th of June, the night when the St. Louis cut the last cable in front of Santiago.

A. W. CATLIN,
First Lieutenant, U. S. M. C.

of Commander Randle, previously and subsequently the worthy commodore of the American Line, who was the sailing master of the St. Louis during the war when not actually in command of her, and my indebtedness to his zealous and never-failing co-operation. In all this he was imitated by the officers and men who served directly under him, and who speedily set up a healthy rivalry in all good things with "the regulars" on board composed of my aid, Ensign F. R. Payne, Lieut. A. W. Catlin, U. S. M. C., and his excellent guard of marines, not to mention four naval cadets of the third class at the Naval Academy, Messrs. Fremont, Williams, Cook and Goodrich.

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TACTICAL CONSIDERATIONS INVOLVED IN THE DESIGN OF THE TORPEDO-BOAT.*

By LIEUT. A. P. NIBLACK, U.S.N.

Up to a very recent period there were a few large firms in Europe which had practically a monopoly in torpedo-boat construction, and which, in a measure, set the fashions and ordained the types. To-day, however, both in Europe and the United States, almost any shipyard or marine engineering firm, without traditions or previous experience, seems willing to take contracts either on plans or designs of its own or on those furnished by the governments interested. Owing to this breaking away from old traditions and to the enormous advances made in naval construction and marine engineering, we find a resultant uncertainty as to just what is the best type of torpedo-boat. The best means of approaching the question would seem logically to be through a study of its weapon, the torpedo, regarded as the only excuse for the existence of the boat.

An automobile torpedo, launched over water from a rapidly moving and oscillating platform, encounters many variable impulses tending to deflect it from its normal course. The wrong angle of incidence of the torpedo in striking the water may give too deep or too shoal an initial dive, or deflect the torpedo laterally. Moreover, each torpedo has its nice adjustments and peculiarities, which must be learned by trial runs, so that, in general, it may be stated that much practice must be had with a given boat and with each individual torpedo to insure the chances of hitting, when the torpedo-boat has survived the many perils which beset it in getting within striking distance.

* Read at the seventh general meeting of the Society of Naval Architects and Marine Engineers, held in New York.

It may be stated, roughly, that the highest development of the present type of torpedo is one about 16 feet long, 18 inches in diameter, and carrying a charge equivalent to 110 pounds dry guncotton. The highest pressure used in the air-flasks to operate the engines is 1500 pounds per square inch, giving a speed of from 30 to 32 knots at 400 yards, 28 to 30 knots for 800 yards, and 26 knots for 1000 yards. There are, of course, innumerable sizes, shapes and variations. Some carry twice the above weight of charge. Distance and speed are largely matters of pressure and size of air-flask. Some unusually long ones, for coast defense, run as high as 30 knots for 1000 yards and 24 knots for 2000, but, for torpedo-boats, the above length of 16 feet and diameter of 18 inches is about the limit for convenient handling, and for weights of mounts and accessories, as the weights increase unduly for small increments in dimensions.

The torpedo is not a delicate instrument, and, after seeing many trials under varying conditions, one comes to feel that it is almost animate; but, for all that, there is a popular mistrust of its ultimate value as a weapon, in spite of what its advocates claim for it; and yet, curiously enough, the world is not yet alive to the fact that a complete revolution has taken place in the status of the torpedo by recent inventions and improvements. It now has a secure and permanent place in naval warfare, and it only remains to accept the fact.

The first improvement is the application of the principle of the gyroscope to the steering rudders of the torpedo, and the second is the perfection of apparatus that will safely and accurately launch torpedoes from the under-water broadside of a rapidly moving ship. The latter practically does away with above-water discharge in large ships, and the former has doubled the accuracy of fire.

In the Howell torpedo, the invention of Rear Admiral J. A. Howell, U. S. N., the motive power is a fly-wheel spun up previous to launching, and the remarkable results in directive force and persistence of the torpedo by the gyroscopic action of the fly-wheel has led to its adoption in a miniature form as a separate attachment to an ordinary torpedo, involving no radical changes in design, since it takes the place of a certain amount of ballast and merely adds a pair of rudders and a few connections. The first practical design of this was by an Austrian, named Obry,

been adopted in our navy, we may assume that in the future we may count tactically on these latest inventions being used, at least in large ships.

If we consider the conditions under which a torpedo-boat may be reasonably expected to be effective against a ship or the ships of the enemy, we will find that an attack, to have a reasonable chance, must be a surprise. Hence darkness, fog, mist, snow, and rain are the favoring conditions. Heavy rains are particularly favorable since, for the defense, the eyes of lookouts are punished severely by the water, it is hard to keep men constantly at the battery, the searchlight is worse than useless, sights are blurred, and outside noise is deadened by the fall of rain. Attacks are made in groups of boats, and it is this which we lose sight of in the United States. A single boat would only attack as a forlorn hope, and under most extraordinary circumstances. All torpedo-boat attack must be in groups, and must be, as in polo or football, or any other similar game, a question of "team work," of "interference," of strategy, head, and nerve. Of all things, it is a question of system. A ship or a squadron attacked simultaneously from various directions must destroy or drive off all the attacking boats or take the consequences. Feints will naturally be made. The first boat or boats discovered will advance fearlessly, dropping and scattering small incandescent buoys to disconcert the aim and create the illusion of numbers, and, if so fitted, use their searchlight. Under strong excitement it is peculiarly human to yield to the temptation of shooting at a light without reasoning. Meanwhile, some one or more boats will get in their torpedoes from an unexpected quarter. Numerous tests at manœuvres in many navies have shown that it is astounding how often torpedo-boats get in *without being seen* and when *expected*. Some people go so far as to say that the searchlight beam is the safest path of approach, and, in one navy, they practice running in it so as to get accustomed to the glare and to judge distances.

In approaching to the attack, previous to discovery, reduced speed must be used so as to avoid white bow waves, smoke and flame, and that peculiar and far-sounding hum which accompanies fast-running machinery. Once discovered, or once within striking distance, high speed becomes important, but it takes some little time to attain it after having once slowed. As between a

speed of 20 and one of 30 knots, the time it takes to cover 1000 yards is only as 90 seconds to 60 seconds. Can the 30-knot boat pass from 20 to 30 knots in 30 seconds? If you can build three boats of 22 knots for what two of 30 knots cost, and if the greater the number of attacking boats the better the chances, is it not wise to forego phenomenal speed? This craze for great speed is illogical and tactically it is indefensible. Back of it is generally an advertisement for somebody. People who handle torpedo-boats have never sanctioned it. What they do ask is that boats be built in groups on identical designs, and that every reasonable effort be made to standardize fittings. As long as fittings are standardized, we may improve groups progressively from year to year as experience dictates.

We are boxing the compass in our torpedo-boat building programme, and there seems to be no known relation between horse-power and displacement. The real excuse for the boats is that they shall carry torpedoes. Let us look abroad and learn lessons. To say that we have not yet had experience enough to warrant us in standardizing fittings is begging the question. From a military standpoint the standardizing is more important than that the fittings should be the latest complicated invention, largely experimental. It is a simple matter to decide, for instance, that all boats shall have the same size and type of water-tight doors, hatches, conning towers, hatch-covers, manholes, bunker-plates, anchors, cables, winches, steering engines, annunciators, telltales, galleys, deck-chests, navigation supplies, fenders, reels, compasses, torpedo-cranes, awnings, whistles, sirens, bunks, mess-tables, etc. This would do to start with, but the logical culmination of the idea is to build the boats in groups with interchangeable parts.

Before taking up the question of the proper relation between tonnage and horse-power for first-class torpedo-boats, let us look at some of the questions of detail, as illustrated by foreign practice. We regard it as essential, apparently, that a torpedo-boat of considerable size shall have twin screws. Great Britain has nearly 100 first-class torpedo-boats, varying in tonnage up to 130 tons, and of which only one has twin screws. Austria has 30 of from 78 to 134 tons, all single screw. In Italy twin screws are used above 100 tons displacement, and single screws for boats of less tonnage. In France, with some 225 or more torpedo-boats

of from 75 to 150 tons displacement, all have twin screws; but, below 75 tons, single. In Russia, of the first-class boats of from 75 to 140 tons, only one group of seven has twin screws, although there are several other groups building in which this is also true. The vast majority are, however, single screw. In the Baltic countries, Germany, Denmark, Norway and Sweden, practically all boats are single screw and have bow torpedo-tubes. Nearly all the boats built by Schichau, of Elbing, Germany, are single screw, and this firm has built about half of the torpedo-boats of the world, but these boats have a bow rudder which may be raised or lowered at will, and which, when in operation, increases the manœuvring power very much. This device is equally important in many of our twin-screw boats, since the pivot, in turning, is almost at the fore foot, and turning is best accomplished by throwing the stern about with the screws. A bow rudder would shift the pivot to about midships, and improve the manœuvring power considerably.

As to bow torpedo-tubes, we regard them as a folly, yet most of the boats of the world have them, and there is not, in Germany, a fighting vessel of any type, built or building, which does not have a bow tube either above or below the snout of the ram, below being the accepted position now.

As to the argument as regards single *vs.* twin screws, the former with bow rudders handle quite as well as the latter without, and it is claimed for the single screw that: (1) There is a great saving in oil with only one engine, and, when we consider that with two it takes about twenty-five gallons a day, this is important. (2) It takes fewer men to look out for one engine, the saving being at least two or three. (3) There are fewer moving parts, and, therefore, less chance of breakdown, while, at the same time, sufficient horse-power can be developed to give reasonable speed. (4) The weight and space of machinery is less, and greater strength can be afforded. After all, reliability of machinery is a matter of design, of material, and of high-class workmanship, and single screws have quite as much to commend them as twin, provided sufficient horse-power can be developed. One of the great drawbacks to single screws is that their draft of water is greater, especially for boats with a skeg, or keel support for the heel of rudder, although in some of the Thornycroft and Yarrow boats there are no supports for the rudder, and thus some inches of draft are saved.

Germany they use, very largely, a German product called earth oil, unfitted for refinement, and they burn it on the Italian system (cuneberti), but principally as an auxiliary fuel for high speeds and for starting fires quickly. The Russian refuse oil is used in Italy, and it is stored in tanks at the principal dock-yards, there being on hand a large reserve for war. Practically, all of their torpedo-boats and fully thirty of their largest men-of-war use liquid fuel either entirely or as auxiliary to coal. In Russia experimenting goes on apace. Our country, of all others, might well adopt liquid fuel, although the purity of the ordinary petroleum and lack of residue makes it necessary to conduct experiments. Its evaporative efficiency as compared with coal is as 2.27 to 1. For the same storage capacity it adds 60 per cent to the radius of action of a boat; it can be delivered at sea from tank steamers in a few hours and in bad weather; it is absolutely free from danger of explosion and ignition, which coal is not; the amount used can be regulated accurately; forced draft does not require extra work on the part of any one; there is no need to transport fuel long distances as with coal; it prevents rust in bunkers; if a bunker is pierced the petroleum flows out only to the level of the water; it maintains steam more economically at anchor and in running slowly; the boiler does not choke; there are no ashes to hoist; it is easier on the boilers; it does away with coal-passers; a water-tender can also fire; and above all, it enables us to get steam quicker and to vary the pressure more easily at will. There is one thing to be considered, and that is that the compressed-air method of feeding commends itself in preference to the steam jet, because in the first place the air-compressing machinery must be in every boat anyway, and in the second place, the radius of action of a torpedo-boat is absolutely limited by her fresh-water supply, and not so much, as supposed, by fuel, although, of course, it takes fuel to distill water. It is in this question of fresh-water tanks and storage capacity that all these fancy yachts and phenomenal torpedo-boats prove failures for hard sea service.

One of the most important questions to be asked about a torpedo-boat outside of the motive power is as to the capacity of her distillers and tanks. Moderate, reliable sea speed coupled with large capacity for carrying and distilling fresh water is the fundamental requirement. Distilling ships to accompany ships

operating from a distant base are a modern naval necessity. Fresh water represents time and coal, and is not so readily obtained as coal, at least as a commercial article. With liquid fuel, a navy will have to provide itself with tank steamers for both fuel and water, more especially if the method of burning it is by the use of steam spray or jet, but even using the compressed air spray the amount of water required to make up feed-water is astonishing.

All this suggests the question, "What are the desirable characteristics of a first-class sea-going torpedo-boat?" The answer here given is: (1) It should be as small as is consistent with seaworthiness, so as to offer as small a target and be as little visible as possible, and, at the same time, should offer a reasonable stable platform for its torpedo-tubes. (2) It should be designed to have as small a bow wave as possible; its machinery should be as nearly noiseless as practicable; and it should not show flames or smoke from the stacks. (3) It should have a large fresh-water tank capacity and be fitted with two smaller evaporators and distillers in preference to one larger one. (4) It should have a reasonable bunker capacity. If for coal, the design should have in view the future use of liquid fuel. (5) The efficiency of the boat depending so largely upon the physical condition of the crew, habitability should receive due consideration in the design. (6) Speed is not essential, although desirable, but a moderate reliable sea speed, obtained without forcing and without noise, flame and vibration should be striven for.

The use of liquid fuel best avoids the question of flames and smoke from the stack, and noisy machinery and bow waves are best avoided by moderate speed secured by reliable machinery and boilers of ample power normally. A speed of 22-23 knots on a maximum displacement of 110 tons is here suggested for sea-going torpedo-boats, and 45 tons for harbor-defense boats, or boats of the second class. We have in the Morris and the Talbot, built by the Herreshoffs, a near approach to the ideal boats of the first and second class. Boats above 110 tons are too large to go through the systems of canals in the interior waterway which connects New York with South Carolina. On the Pacific Coast, except about Puget Sound, all of the harbors are practically bar-bound in bad weather, and first-class torpedo-boats will not prove as desirable as second-class ones, which are

intended only for local harbor defense. Since the coast is so remote from any possible enemy, even a torpedo-boat is a luxury, although a number of sea-going torpedo-boats and destroyers will be required on the Pacific Coast for drill and training purposes, and in Puget Sound for service.

FIRST-CLASS SEA-GOING TORPEDO-BOATS OF SEVERAL NAVIES.

Country.	Date.	Where or by whom built.	Length (ft.).	Beam (ft.).	Draught (ft.).	Displacement (tons).	I. H. P.	Number Screws.	Extreme speed (knots).	Complement.	Coal (tons).
Austria	'95	Yarrow	147.5	14.7	6	107	2200	1	24	26	30
Denmark	'93	Copenhagen	140	14.3	7	114	1300	1	22	24	25
France	'92	Gruville	147.5	14.5	5	114	1550	2	24	34	20
Germany	'92	Schichau	144.4	16.5	7	110	1500	1	24	24	30
Great Britain	'87	Yarrow	135	14	6	105	1540	1	23	21	30
Italy	'97	Italy	135	14	5.3	110	1600	2	25	20	30
Russia	'91	Russia	128	15.7	6.9	98	1250	1	21	13	17
United States	'96	Herreshoff	139	15	4.1	103	1750	2	22.5	26	28
Approximate average	'93		140	14.8	6.0	108	1560	1.4	23.2	23	24

The foregoing table shows the principal characteristics of a certain number of sea-going torpedo-boats of several countries, selected to correspond to a displacement of about 100 tons, but not as representing the standard type, although it may reasonably be assumed that any given boat represents the best at a given date of building. The "approximate average" is, of course, somewhat misleading, but is suggestive. As regards twin *vs.* single screws, it does not prove much. Both the draft and speed of the Morris are greater than given officially, although draft up to a certain point is a matter of little importance, since it is unsafe to fire a torpedo in less than 30 feet of water, owing to the possible initial dive. For canals, 6 feet is not too much. It is estimated that for a boat of about 110 tons displacement it will require about 1550 horse-power to drive her 23 knots, and 3100 horse-power for 30 knots; in other words, about twice as much. Of course a great deal depends upon the design of the boat.

Since 1893 the size of torpedo-boats has increased very considerably, as in France, where the latest type is 150 tons and 4200 horse-power, with 30 knots speed; Germany, 140 tons displacement, 2500 horse-power, and 25 knots; and Italy, 150 tons, 2700 horse-power, and 25 knots.

Just before the war with Spain, the United States bought at Schichau's, Elbing, torpedo-boat No. 450, now called the Somers. She is a single-screw boat of 143 tons displacement, 1700 horse-power, and a speed of 23 knots, and was built, in 1893, on the same lines as a group of other boats for the German navy, but with a quadruple-expansion instead of a triple-expansion engine. As there was no advantage demonstrated in the departure from the standard triple-expansion type, the German government declined to purchase her, and she was later offered to us. I personally recommended her purchase on the ground that whether or not she could be gotten across in time to be of service in case of war, she was a model boat, in many respects, since she was fitted with all the articles so carefully and systematically standardized through all these years by the German navy, and there is not a detail in her that has not its lesson for us. Far from being a failure, as many believe who talk and never think, I personally conducted her trials, which were satisfactory, and would consider it an honor to command her.

In the torpedo-boat discussion last year the following remarks were made [Transactions, Vol. VI, p. 66] which so nearly represent the exact opposite of what is here advocated that they are worth quoting: "I believe we are very far from the final results under the extreme speeds, and as to advocating a slower boat than our enemy has—why, it will undoubtedly place us in a hazardous position. . . . I believe there is plenty of ability in the country to develop men who can handle the more refined type of torpedo-boats, and I believe that it should be invited and should not be condemned any more than the use of the chronometer should. Without careful treatment it is certainly useless, and the torpedo-boat is undoubtedly recognized as being a refined machine." There is a good deal of misconception in all this. A fleet operating on an enemy's coast has with it torpedo-boat destroyers. Their base is the fleet; their purpose, to hunt out and destroy the torpedo-boats of the enemy. To say that it is hazardous to have slower torpedo-boats than one's enemy is

to imply that torpedo-boats attack torpedo-boats. The technical opinion is that torpedo-boats operate from a port as a base. If two hostile ports are adjacent, then it might mean something. Of course, a destroyer can overtake a torpedo-boat, or is designed to do so. In a heavy sea an 18-knot cruiser might overtake a 30-knot destroyer. As regards a torpedo-boat being a "refined machine," every effort should be made to get it out of that category. Of course, a torpedo-boat needs skillful and intelligent handling, but the cavalry does not use race-horses and high-stepping hackneys do not make good polo ponies.

In conclusion, let it be understood that real progress is just as admissible with standardized fittings as with chaos. We can also learn several lessons from recent events. The Oregon and the Iowa gave a beautiful object-lesson when they cut loose from a base in New York and reached, the one San Francisco, Cal., and the other, Manila, P. I., without having to rely on any supplies other than those they had in the auxiliaries accompanying them. Lieutenant-Commander W. W. Kimball, U. S. N., has proposed that we adopt for sea-going torpedo-boats a similar scheme; that a certain number of boats in a group have as a base a large depot steamer to carry coal, liquid fuel, oil, water, waste, compressed air, spare parts, medical officers, relief officers and men, stores, supplies, repair-shops, etc. This will enable us to shift the base from point to point, and make a fewer number of torpedo-boats cover a wider stretch of coast. With such a long coast-line as we have, we can never afford to have all the torpedo-boats required. This would mean sea-going torpedo-boats for coast defense, and second-class boats for harbor defense, which is technically correct. Torpedo-boat destroyers, operating from a fleet as a base, would accompany said fleet wherever required to assist in protecting it from attack by the torpedo-boats of the enemy; in other words, in operations on the enemy's own coast. This view of the use of destroyers and first and second-class torpedo-boats is in conformity with modern tactical and strategical ideas.

PROFESSIONAL NOTES.

BRITISH AND FOREIGN NAVIES.

The amount now voted annually for the maintenance of the British navy is beyond all precedent. As shown by a diagram in "Brassey's Annual," our expenditure on new construction—which is the foundation stone of naval expenditure—has risen from about £800,000 in 1872-3, up to £9,200,-000 during the present financial year, ending the last day of March next. The chief rise has been since the financial year 1893-4, when the total was no more than £3,000,000 sterling.

A government return has just been issued showing the fleets of Great Britain, France, Russia, Germany, Italy, United States, and Japan. The number of vessels in each class, built and building, is given, together with the names, displacement, and armament of each ship and the date of launching of vessels that have been launched. The return is useful, inasmuch as it gives in convenient form figures which bear the official stamp. It might be wished that further details were given, but under the three heads named the chief factors of efficiency are contained, for if we know the size of a ship and her date, we may conclude that the designers worked into her composition a fair balance of advantages, looking on displacement in the light of the "capital the constructor has to work upon." This, of course, assumes equal skill on the part of all designers, which may be far from the truth, but directly one comes to appraise the value of different elements of design, the task becomes so complicated as to be almost hopeless. In 1885, shortly after retiring from public service, Sir Nathaniel Barnaby published at his own expense an exceedingly useful "return," in which the strength of the British, French, Italian, German, and Russian Navies respectively was shown by means of some cleverly devised diagrams. Our most powerful battleships then laid down were the Nile and Trafalgar, designed by Messrs. Barnes and Morgan, Chief Constructors, and the public was informed that these would probably be the last large ironclads built. Exactly what this meant—whether external armor should be abandoned, or that ships of large size should be quite unarmored—was not generally known at the time, and now it is of little consequence, as the prediction has been so completely falsified by events.

The late Director of Naval Construction also stated in his publication that a considerable section of ships had been kept short and low in engine power to encourage the use of sails. That was written nearly fifteen years ago; and in spite of the lessons learned since then, there are, one would almost think, a certain number of naval authorities—the term is convenient—who would approve the same course; at least, that is the impression we get from reading a recent correspondence.

Sir Nathaniel Barnaby refused to believe that the maximum limit of size for battleships had been reached with the 12,000-ton Nile and Trafalgar, and we see by the Admiralty return how this forecast has been

amply fulfilled. He appeared, however, to lean to the opinion that side armor would disappear from large ships. It is interesting to note that in 1881 "all the constructors" of the Admiralty, including, therefore, Sir Nathaniel himself, as well as his colleagues, Messrs. Barnes, Morgan, and White, the latter now Sir William White, concurred in recommending a design for a battleship of larger size than any up to then constructed, in which there was an entire absence of side armor, although 28½ per cent of the displacement was devoted to armor. The vessel was not built, and the introduction of high explosives shortly after so revolutionized the conditions of attack and defense that we shall never know whether the Admiralty constructors would have been justified in their advice in case of a naval war.

Turning from the past to the present parliamentary return, we find we have nine 14,900-ton first-class battleships of the Majestic class, and the eight hardly less important 14,150-ton ships of the Royal Sovereign class. Although it is now nearly nine years since the latter vessel was floated, and just over six years since the Magnificent—she was about a fortnight earlier than her sister the Majestic—took the water, yet these seventeen vessels alone form a fleet of two homogeneous and symmetrical divisions unparalleled in offensive and defensive powers (if the two can be separated) by an equivalent number of ships belonging to any foreign power. These magnificent vessels are well supplemented by such ships as the Renown, the Barfleur, and the Centurion, all of which have been proved at sea; and by the six 12,950-ton ships of the Canopus class; whilst coming down to quite the present day we have the six monitors—Formidable, Irresistible, Implacable, London, Venerable, and Bulwark, of 15,000 tons each, and all launched. There have yet to consider, as ships unlaunched, the six 14,000-ton battleships of the Duncan class. To these may fairly be added the older ships, such as the "Admirals" and others, of which we are somewhat apt to speak a little contemptuously, but which would be of supreme importance if the more youthful and vigorous champions of the sea had been well pounded in a close engagement, and had to seek a port to refit. It would be well if the cruiser branch of the navy were as well represented as our line-of-battle. We have some fine ships—big, powerful, and good sea-keepers—but the numbers would not be sufficient for our needs if we were opposed to a combination of powers that heavily taxed our line-of-battle. The most conspicuous feature in this division is fourteen armored cruisers now building—four of 9800 tons, six of 12,000 tons, and four of 14,000 tons. The coast-defense ships, which it is to be hoped will never play an important part in war—for it would be a bad thing for us if they were in request—the special vessels, such as the Vulcan; and, lastly, the torpedo fleet, complete the list of a navy such as never yet has been approached in the history of nations, just as the need for such a navy never before existed during the world's record. Compared to our own majestic array, the foreign lists are not impressive.

If we simply count numbers, we find that we have 70 battleships built and building, France has 36, Russia 24, Germany, 23, Italy 19, the United States 16, and Japan 7. A mere statement of numbers is, however, apt to be very misleading. For instance, our list includes such ships as the Bellerophon, Audacious, Iron Duke, Neptune, and Superb—the two latter purchased during the Russian scare. France includes nothing so ancient as the Bellerophon, which was launched in 1865, her oldest battleships being the Richelieu and Friedland, launched in 1873. On the other hand,

some of the older French ships have wooden frames, and can hardly be considered worthy of the line-of-battle even in opposition to our own venerable champions. Russia has one very old ship, the Peter Veliki, launched in 1872. Germany has one of 1874, and two of 1878. Italy has three small ships launched in 1863, one in 1864, and one in 1865; but these are such small craft—from 3851 tons to 4619 tons—that they can only nominally be classed as battleships at all. The Italians, however, have yet the two largest battleships afloat, the Lepanto being 15,549 tons displacement and the Italia somewhat less; whilst our own Formidable and her five sisters are only 15,000 tons each, and the three big Japanese vessels are 15,200 tons each. These two Italian ships, however, as well as other big Italian vessels, have no side armor, though a great weight of heavy projective plates is worked into their structure; but in view of the introduction of high explosive shells and quick-firing guns, it is doubtful whether these two monster vessels would stand long against much smaller craft. They have, of course, other qualities, such as high position of heavy armament and good steaming qualities, to a remarkable extent, considering the date at which they were designed. Of course, high speed is little qualification for the line-of-battle, but is useful rather in getting away from it. The United States ships are all modern, as are those of Japan. The length of the list of battleships possessed by the Japanese is by no means a measure of the power of their line-of-battle fleet; they having, built or building, six ships that would be capable of wiping off the effective list a very long tail of the ships of other powers if the question was put to the test of powder and shot.

If instead of considering the most ancient ships we take those that would doubtless bear the brunt of war standing in the first line of battle, we find that since 1890 we have 38 vessels on the list built and building, 32 of which have been launched. They are all big and powerful ships, the smallest being the Barfleur and Centurion, each 10,500 tons displacement. All but 10 are between 14,000 and 15,000 tons. France has on the list 17 ships commenced since the beginning of 1890. They are much smaller than our battleships, however, ranging between 6691 tons and 12,012 tons, there being only two reaching 12,000 tons, the Bouvet and Suffren. All the French battleships have been launched, but four are not yet completed. The Russians have commenced 18 battleships during the last ten years, 11 of which have been launched. In size the Russian ships are superior to those of France, ranging from 8440 tons up to 13,304 tons, there being three of the latter size in progress; namely, the Borodino, the Emperor Alexander III. and the Orel. Germany has 17 battleships of the 'nineties on the list; four are not launched and three are not completed. Some of them are quite small, seven being 3000 and 4000 tons. The last three on the list, with which comparatively little progress has been made, are the largest, being 11,800 tons each. The others average something near 10,000 tons each. Italy has but four battleships of the 'nineties, the Sicilian and Sardegna, of over 13,000 tons each, and two ships, launched in '97, but not completed, of 9645 tons each. The United States battleships are all of the last ten years. They are 16 in all, six not launched, five launched but not completed, and five in service. They are all above 10,000 tons, except the Texas, of 6315 tons, the three last projected, which are the largest, being 13,500 tons each. If we except the converted Chin Yen, all the six Japanese battleships belong to the last half of the 'nineties, and the smallest is the Yashima of 12,300 tons, whilst, as stated, there are three over 15,000 tons.

To make a comparison between the cruisers of the different countries would be an endless task, and one unsatisfactory however elaborate the list might be. The need for cruisers varies with the maritime importance of a State far more than does the requirement for battleships, which is a much more determinate quantity. It has been laid down as a general principal that there should be three cruisers to every ship of the line, but here again the need varies with the duties for the time being carried out by the battleship. The problem is further complicated by placing armor on cruisers, a plan we seemed to have abandoned until it was revived recently. We have now fourteen armored cruisers in hand ranging from close on 10,000 tons to over 14,000 tons. Of protected cruisers of all sizes, we have 107 built and nine building. There are also fifteen unprotected cruisers; so we have 136 cruisers in all. Some few of these are of ancient date, and hardly to be classed as war vessels. Three special vessels—the torpedo-gunboats, torpedo-boat destroyers, and torpedo-boats—complete this unrivaled fighting fleet. France has 50 cruisers all told. Among her other remarkable craft, she has four submarine boats built and eight apparently in progress. Russia has 26 cruisers in all, Germany 43, Italy 23, the United States 32, and Japan 32. Our need for cruisers is, it need hardly be said, incomparably greater than that of any other power.—*Engineering.*

NAVAL POWER AND COST.

Germany has practically decided to double its navy within the next 16 years. The proposal has passed the Federal Council. This will bring the numbers to 40 battleships, 20 first-class cruisers, with a large addition to smaller craft. This means with docks, etc., an extra vote of 93 million sterling. An immediate increase on the yearly estimates of nearly 10 per cent also brings them up to £3,700,000. Thus Germany has decided to raise at once her naval expenditure from £3,400,000 to £9,650,000 per annum. The French are even more ambitious, for in seven years they propose to spend on new ships yet to be laid down 19 million sterling, and on the completion of ships now in course of construction £9,400,000, altogether 28½ millions on new ships; while harbors, submarine cables, and other immobile works bring the total to over 36 millions. When this is added to the expenditure on other naval services, we have an annual expenditure of nearly 13 millions a year. The new ships to be laid down include six battleships, five armored cruisers, 28 torpedo destroyers (contre-torpilleurs), 112 torpedo-boats, and 26 submarine, or submersile, boats. Russia has not yet embarked on a corresponding programme—not avowedly; but apart altogether from British movements, she cannot be quiescent with Germany's possible menace of her position in the Baltic, as well as in China, where also even France is a contestant, while both Germany and France have even a greater stake than Britain in the Mediterranean, with the Black Sea beyond. Russia's ordinary estimate for this year is nearly 11 million sterling. Britain spends now 27 millions on her navy, against France's proposal of 13 millions and Germany's £9,650,000, and thus we have for four nations 61 million sterling. If we include the expenditure on armies of the four countries, we have for Russia 44½ million sterling, for Britain 45 million, for Germany 41 million, and France 42 million, in all 172 million sterling for the four powers. One of the French

government officials remarked in a report on his government's estimates, "What a disastrous weight for modern civilization!" This takes no need of possible—almost inevitable—increase in Britain.

In this war of war expenditure it is important to inquire into the purchasing value of the outlay, for it bears directly on the results of the contest. It is scarcely desirable to enter minutely into details, but it is easy to prove that on the heaviest item—on the munitions of war—we have a great advantage in the less cost of construction. Our latest battleships, with all modern expensive equipment, cost us, complete with guns, £71 odd per ton of displacement, which is as fair a basis of comparison as it is possible to get. The battleships which the French are now building, and those they propose to lay down, certainly not superior to our own so far as the prospective design shows, cost £90 to £95 per ton displacement. Germany's earlier turret ships cost £72, and Russia's new ships about £100. Taking armored cruisers, our Cressy class are to cost about £64 10s. per ton displacement, and the cost of the corresponding ships of the other powers exceed pretty much in the same proportion as with battleships. The comparison might be continued to other classes, but it may be taken generally that French ships are about 30 per cent costlier, and Russian ships 40 per cent dearer, than British ships of equal power. In other words, for the money voted for a battleship for France or Russia, we can build a 5000-ton cruiser also; or we can build four battleships for France's three, all being equal, and six for Russia's four. If we spend the same as both nations together, we get ten for their seven ships. This, however, is a condition which time, with its experience, is nullifying, although perhaps slowly; so we must continue to spend more, even if we get more for our money.

The next question which arises has reference to the ability to bear the burden—a most material consideration, for Micawber's philosophy of household economy and the relation of income to expenditure is as operative with nations as with others. France has admittedly a difficulty in making her revenue at the present time keep up with her expenditure, and the new naval programme has been promised without an increase in taxation. It is, to say the least, difficult to understand how this promise is to be fulfilled; but Britain can afford to view with complacency the prospect of progress in the construction of French ships being delayed owing to the absence of revenue. We have had experience ourselves of this—France's besetting sin to-day—because ere yet our politicians were aroused to the full value of supremacy at sea, this was more or less a chronic condition here. That, however, is long since past. France, as well as Germany, has recognized that there is at least the prospect of continuity of policy if a large addition is authorized at one time; but continuity of construction is not likely to be insured, unless there is at once adequate allowance of money. Sea power costs money. Our taxpayers now fully recognize this, and are ready to back the bill. It remains to be seen how far the Frenchman, the German, and the Russian will accept the same truth. In this financial struggle it is well to consider the weapons available—the countries' resources, as measured by their commerce, their producing capacity, their wealth, and their debts. Space forbids an excursion into minutiæ, even if such were desirable; but recognized statisticians have reduced the facts to simple comparative units, which for most practical purposes are accepted by all.

Britain profits by its preponderating share of the world's commerce,

22 per cent falling to her lot. Germany has just half this portion—10.9; France, 9.2; and Russia, 3.5 per cent. Britain's trade turnover, foreign imports and exports, are also about double those of Germany, and enormously exceed the other two competitors in this war-expenditure game. Germany stands most favorably as to her total debt, but Great Britain excels in material wealth. The figures last available for comparison with all countries are those of 1896, and then Britain's national wealth—first among the nations—was equal to £290 per capita, France's 242*l*, and Germany's 150*l*. When we turn to the debit side of the ledger, France's position is greatly affected, as her debt is more than double that of Britain's, constituting 12 per cent of her wealth, against 5 per cent in our case. In other words, Britain pays interest to the extent of 8s. per capita; while if she had France's debt, she would have to find 20s. from each inhabitant, great and small. Taking the population of Britain at 40 millions, this difference in debt alone should enable us to spend 24 million sterling on our navy without exceeding the average burden in France. This fact alone should be reassuring. The French government official whom we have already quoted has stated that "the burden is heaviest on France, which has not the population of Germany or Russia, nor the wealth of England, but has an unparalleled debt bequeathed by the blunders of former governments." As compared with Germany, our position is not so pronouncedly favorable; but with a national wealth, after allowing for debt, of 11,170 million sterling, as compared with 7937 million sterling, we can better afford to enter upon this new contest with equanimity. The government, thus forced by competitors, can easily play the game.—*Engineering.*

FRENCH SHIPBUILDING.

Once again the French naval programme has shifted, and now—provided always that a fresh programme is not evolved between the time that these lines are written and their appearance in print—the pretty theories of a *guerre de course* are at a discount. The battle squadron is, for the instant, the order of the day, and ten battleships, together with ten large armored cruisers, are spoken of; while the building of two out of those nine submarines that figure in the last parliamentary return is postponed to the *Ewigkeit*, and generally the "new school" has been repulsed. As for the submarines, the countermanding of the two latest is, perhaps, hardly a question of schools, since their particular type-ship, the Narval, does not appear to come up to requirements. She is said, in fine, to exhibit a tendency to float bottom upwards—a state of things that "is expected to interfere with the comfort of her crew, and to hamper her docility," all of which we are quite prepared to believe, given the truth of the reported instability. Experiments with such comparatively unknown factors as submarine boats are, however, one thing; the proposed construction of fighting ships upon accepted models, another. It is this last that we propose to examine.

First, as to cause. Hitherto the French programme has been governed by that of Great Britain, and the opponents of big ships have always pointed out that if France lays down a battleship extra, this country replies with a couple. Therefore, they have argued, it is useless to build battleships with which to fight perfidious Albion. "Fast cruisers" has

been the watchwords of this party, and for a year or two its influence has been visible in French shipbuilding. Craft like the Guichen, Chateaurenault, and others, very swift and very little armed, have been built specially for that form of piracy known as the *guerre de course*. After embarking upon this programme, some one in authority seems to have started thinking; and the wisdom of building "a multitude of swift cruisers"—about three is the present total of the multitude—got called into question. Swift the Guichen undoubtedly is, but everything is sacrificed to speed and coal, so that one of our second-class cruisers could, in vulgar parlance, knock her into a cocked hat inside of a few minutes. The result of these deliberations was that the Guichen idea was abandoned, an armed liner being every whit as suitable for piratical purposes. Thereupon armored cruisers were laid down; vessels able to tackle our protected cruisers without much risk, but—except on paper—slower than the Guichen type. To these we have replied with the Cressy class and others, and on this particular line things seem to have crystallized—the Guichen folly is not likely to be repeated. Indeed, the French are now continually asking themselves why, having evolved such a really splendid type as the Dupuy de Lôme, they ever started building anything else. Expense, and the desire of each Minister of Marine to be original, seem to be the two chief reasons why. However, at present the ship-building barometer is at "set fair" in the Dupuy de Lôme direction. A third reason may be casually alluded to. Great Britain never built any "reply" to the Dupuy de Lôme. In the innocence of their hearts the French administration of the period assumed that we recognized some cardinal defect in that ship, and here was an additional argument in favor of something more cheap and showy. Actually our neglect of the Dupuy de Lôme idea should rather be attributed to oversight on the part of past British Admiralties, and the fact that our people, too, were at that time very eager to find something cheap and showy. The Dupuy de Lôme is not a new ship, her armor is by no means of the latest patent; yet, seeing the angle at which it is inclined, we much doubt whether anything under a big gun could get through it. And we incline to fancy that the Dupuy de Lôme could stand up to our Cressy better than the far more modern Dupetet-Thouars.

So much for France's cruiser programme; we now come to the battleships. These, we think, owe the idea of their inception to Germany—it has dawned upon the French that England is not the only country with a navy, and that while the problem of the best kind of fleet to render safe a policy of pin-pricks has been under discussion, the German navy has been creeping up. Already, in case of a Franco-German war, Germany could defeat the French Northern Squadron and blockade the Channel coasts till reinforcements arrived from the Mediterranean. If Germany's programme be left unanswered, then that power will be well ahead of France on the sea. At present, taking vessels of the first and second battle rank, Germany has five completed—the four Brandenbergs and the Kaiser Friedrich der Dritte. Against these France has the Brennus, Bouvet, Jauréguiberry, Charles Martel, Massena, Carnot, Charlemagne, and Gaulois—eight ships, five of which belong to the Mediterranean. True, France has the four Jémappes type, and the Courbet and Dévastation re-armed—or about to be—as well as some other vessels, such as the Magenta, Formidable, and Baudin, of doubtful fighting value, and which Germany has ships to meet. Half of these, again, are at Toulon, and

altogether Germany would be in a fairly good position to make things unpleasant.

Of the ships being completed, Germany has one, the Kaiser Wilhelm der Zweite, while France has the St. Louis, Suffren, and Henri Quatre—this last quite a second-class ship. This more than preserves the balance, perhaps, but it does little else. In the matter of battleships building France has one other, the Lena, in hand. Germany has about half a dozen. This spells a probable clear superiority for Germany in the near future, unless Russia helped France; and Russia has not much with which to help despite the parliamentary return. If, therefore, France is not prepared to concede naval superiority to Germany she must begin to build battleships at once, for—neglecting the new programme—Germany, as she is, stands to get ahead of her old rival, and to be able comfortably to beat her in detail. And since it is hardly conceivable that France will permit this, we may look during the next few months to hear a good deal more about the "glorious mastodons," and a good deal less tbout the "brave *sous marins*." While these last have been winning imaginary future victories over perfidious Albion, Germany has plodded along and mended her weak spot in the war of 1870-71. The *guerre de course* ideal, like several other of her ideals, seems likely to cost France pretty dear. Luckily for her, she seems to have awakened just in time; and if the new programme is carried out she will still remain an important naval power.—*The Engineer.*

RECENT BRITISH WARSHIPS.

It is not our intention in the present article to criticize the work, but to take three typical modern types in the British fleet, a battleship, a cruiser, and a torpedo-boat destroyer, and impartially to weigh up the points in which may be said to lie the essential and governing features of these designs.

An impartial observer making a historical survey of the progress of the navy during the past fifteen or twenty years would be struck perhaps as much by the advance in absolute size of typical ships as by any other feature. This is equally true of battleships and cruisers, and in the following remarks we hope to be able to point out the reasons which, in our opinion, have led to development in this respect. We advert to the question of size, since at any given date this point roughly dominates cost, and hence determines what the British taxpayer must give as the price of his determination to have a navy which shall enable this country to maintain its position as mistress of the seas.

As we were enabled in our issue of November 18th, 1898, to lay before our readers a rough outline of the Formidable, together with a few leading particulars of this ship, we have chosen this vessel as the type of the modern British battleship. To recapitulate briefly, her dimensions are as follows: Length between perpendiculars, 400 ft.; length overall, 430 ft.; extreme breadth, 75 ft.; draught, when in normal condition of load, 26 ft. 9 in.; displacement, 15,000 tons. Considering the offensive powers of the ship, we notice that, excepting perhaps a few light guns, the armament is grouped symmetrically at each end of the hull. Taking one end only, say the bow, we have two 12-inch guns of the most modern type mounted in a splendidly protected position, and from their height above water and

their large arc of uninterrupted training they should render a good account of themselves if needs be. These are flanked by four quick-firing guns of 6 in. calibre, which fire a little across the bow to nearly [illegible] degrees abaft the beam. Then on the broadside the four heavy guns and six of the 6 in. quick-firing guns can be brought to bear. The number and the position of this second part of the main armament has, it is clear, a very marked influence on the dimensions of the ship. In order to avoid interference between the guns they have been placed at considerable distances apart; this in turn has determined the position for the main redoubts, and as it is essential to have these stations well out at the extremities in order that the seaworthy qualities of the vessel may not be impaired, the length of about [illegible] ft. is seen to be the least that can be accepted.

For the lighter form of attack the 12-pounder quick-firing guns are distributed uniformly throughout the ship and form a valuable secondary armament in themselves, as not only are they of especial use as a defense against boat attack, but they supply an efficient means for attacking the lighter works of an enemy's ship.

By reference to the plan previously published, it will be seen how judiciously the guns have been placed; and further, that had a much larger number of guns been installed on board, interference of one gun with the fire of others must inevitably have resulted. This is a point of the utmost importance, in our judgment; we need not name the other disadvantages of more crowded gun-decks, a larger crew, with diminished accommodation for them, etc. After providing an armament, which must be considered excellent, to have each gun placed in such a position that its freedom will be unimpaired by the action of any of the other guns in the ship, and so have its maximum efficiency always attainable, far outweighs the mere glamour of having a larger number of guns, with the certainty that in many cases one gun will be masked by its neighbor, and thus for the time being rendered useless.

Next to the question of guns and their position comes the question of the supply of ammunition, and the means of its convenient transport to the fighting positions. For the big guns this is well provided for by grouping the magazines and shell-rooms vertically between the redoubts, thus arranging for the minimum longitudinal transport of the ammunition. Hydraulic hoists bring both explosive charges and projectiles to the loading positions, which it may be said are independent of the angle of training of the guns, and the rest of the work is easily accomplished.

To minimize labor at the most critical part of an action, a good store of projectiles is carried well up in the redoubts, so that they are within reach without hoisting. The hoist is then entirely devoted to bringing up explosive material, the result being that the officer in charge has the means of accelerating the rapidity of fire to a pronounced degree, a most valuable feature in an engagement. The supply of ammunition to the 6-in. quick-firing guns is arranged in a correspondingly thorough fashion. The magazines and shell-rooms open into roomy lobbies from which convenient and wide passages lead directly to positions beneath the rear of each gun; the ammunition is thus brought to the working positions by the most simple and direct transport, all the time being under protection. As with the large guns, a ready supply of shot and shell is arranged for. Should the action be at close quarters four torpedo tubes, all of the submerged pattern, give an opportunity of using this method of offense in the surest way yet known, and with the minimum of risk to the ship herself. At still closer quarters the ram may be used.

When we note the general defensive powers of the ship, we are of the opinion that the arrangements have been thought out in an equally thorough manner. The armor belt is 9 in. thick, 15 ft. deep, and extends for nearly two-thirds the length of the ship. The material is of the finest quality known. This armor, therefore, worked upon framing of great depth and strength, is so placed as to yield the best possible results in the way of preservation of the ship's stability in action.

At the fore end the side is plated up to the height of the main deck, and down to the point of the ram with special plates 2 in. thick, in addition to the ordinary shell plating. Consequently, when chasing an enemy the liability to perforation of the bow by the lighter guns of the foe is very small. This is an important feature, and conduces greatly to keeping up the speed of the chase. The two protective decks form a double roof over the whole vitals of the ship. The upper is the main deck, and is doubtless intended to compel the bursting of the lighter forms of shells, or, indeed, tolerably heavy shells which happen to strike at small angles. The lower armored deck is of the familiar curved type, and taking position and curvature into account, it forms as complete a protection to the under-water portion of the ship as could well be imagined. These features, together with the division of the ship into numerous water-tight compartments, and a careful disposition of the coal, complete the protection of the hull proper.

Turning to the protection of armament, it is clear that the protection of the 12-in. guns is as complete as it can possibly be made. Rising from the protective deck are two armored redoubts of cylindrical form, which completely enclose the turntables and turntable supports. The armor is 12 in. thick, and is proof against the attack of the heaviest guns at present built, and over each pair of guns is a roomy armored hood to protect the gunners. The 6-in. guns are each placed in a separate casemate with 6-in. armor fronts and 2-in. backs. The protection afforded to their crews is by no means small, and the system of isolating each gun in this way ensures practical immunity to the crew from damage from the fire of small guns and from the explosion of comparatively large shell and the scattering débris necessarily existent in an action.

We have alluded to the transport of ammunition in our remarks on the armament. We will only repeat that it is brought from the magazines to all the guns of the main armament under cover of the armor, thus altogether avoiding exposed transport of explosive material. As regards speed it is estimated that the vessel will attain a velocity of 18 knots on the measured mile at normal draft. After long experience of the admirable speed performances of the vessels preceding the Formidable, we cannot doubt but that this anticipation will be quite realized. It must be fully understood that when this speed is attained in the trial condition, as it assuredly will be, it implies no guarantee that under all and every condition of service the ship will be propelled at this rate of motion. It does imply, however, that a powerful installation of machinery has been fitted on board which, with proper management, will enable a high continuous speed to be maintained while the coal lasts, and in this respect we have no hesitation in asserting that the Formidable is fully equal to, if not somewhat better than, any battleship at present built which she may ever be expected to meet. In our judgment it is unnecessary to dwell further upon the qualities of the modern British battleship. Much could have been said as to the thoroughness of the equipment in many other

respects, the arrangements made for the comfort of the officers and crew, etc., but space forbids.

When we come to consider a typical cruiser, we are face to face with the fact that we can hardly find a type of ship so completely representative of the general body as is the case with the battleship. While, of course, there have been differences in designs of battleships, the battleships within the past ten years built or building, thirty in all, have all ranged within narrow limits of displacement; the Renown being at the lowest point of the scale, with a displacement of 12,350 tons, and the vessels of the Formidable class at the other extreme, each with a displacement of 15,000 tons. A much greater variation in the size of cruisers has been found to be necessary in order that the multifarious duties devolving upon the fleet may be satisfactorily carried out. During the same period as that mentioned above, cruisers have been built ranging in displacement from about 3000 tons up to normal displacements of over 14,000 tons.

When we consider the ever-increasing growth of our mercantile marine, and the increase in average speed of voyage which has been made in recent years, there is not the slightest doubt that the Admiralty has done well in determining to lay down four ships of the Drake class, with a view to the protection of our great maritime routes, and as an answer to the policy pursued by other nations in building commerce-destroyers; it being tolerably evident that, excepting ourselves, there is no other country in the world whose commerce is very much worth a serious effort to destroy. From the particulars of the vessel which have been made public from time to time, we think it may fairly be inferred that the key to the design is speed, a high speed under measured mile conditions, and kept up for such a time as will ensure that it is no mere spurt, but that it affords every ground for expectation that a high rate will be maintained for the whole period over which the coal will last. Associated with the question of speed over prolonged periods, is the question of how much the speed is likely to fall off under stress of weather; the large size of these ships and their great height of freeboard, especially forward, make it certain that they will suffer comparatively little in this respect. Coming to particulars, we may say that the dimensions are as follows: Length between perpendiculars, 500 ft.; length over all 533 ft.; breadth extreme, 71 ft.; normal draft of water, 26 ft., this draft, as in the case of the Formidable, making a passage through the Suez Canal both a certain and easy operation.

We have in general terms already alluded to the matter of speed in this vessel. This point stands out prominently both as a means of offense and of defense. It will enable her to overhaul any vessel in the course of a comparatively short time. When the character of any strange vessel is made out, even should the Drake be under easy steam at the time with a large portion of the boiler power not in use, the water-tube boilers which will be installed will enable steam to be raised in the minimum time, and a chase ought to be a matter of short duration. Her armament is well balanced. A 9.2-in. gun of modern type is mounted on the forecastle, at a commanding height above water, and with a horizontal arc of 270 degrees; a similar guns is placed aft, with the same arc of training. The remainder of the main armament consists of sixteen 6-in. quick-firing guns, symmetrically disposed, and of which four can fire right ahead, four right astern, and eight over a large arc of training on each broadside. The remainder of the gun armament is made up of fourteen 12-pounder

quick-firing guns, with small boat guns and Maxims in addition. Though an enormous space in the ship must be taken up by machinery and boilers, room has been found for the submerged torpedo tubes.

Equally with the Formidable, the great care with which the armament has been disposed is manifest; each gun has a very large and uninterrupted arc of training. We must not enter into any details regarding the service of ammunition, merely remarking that it is quite as thorough as in the Formidable, and that under these circumstances the gun will be quick-firing in actuality as well as in name.

When we consider the defensive qualities of the ship, it is evident that the most active defense is undoubtedly her speed; she should, therefore, be able to avoid action with an enemy more powerful than herself. As a means of protection to the hull it is to be noted that an armor belt 6-in. thick is worked over about half the length amidships, and extending to the height of the main deck. At the after end of the belt the protection is completed by a transverse armored bulkhead. Forward, the armor extends to the bow; the thickness is somewhat diminished, but its depth below the water-line is maintained, and the height above water is increased by at least 8 ft.; thus strongly fortifying the bow against the attack of a retreating foe, and as in the Formidable, minimizing the chances of retardation of speed due to perforation of the bows. Two protective decks are worked in accordance with the latest practice.

The protection to the armament next calls for notice. On a cruiser, however large, amor in any quantity is a serious factor in the situation if a high speed is aimed at, and it is no wonder that the designers have found it impracticable to give as much protection to the armament as in the case of the heavier and slower battleship. The heaviest guns, however, come in for a substantial measure of armored protection, and each 6-in. gun is isolated in an armored casemate with front plates 6 in. thick.

The arrangement for the supply of ammunition is of the same general character as that we have already described in the case of the typical battleship.

It is expected that 30,000 indicated horse-power will be developed in the course of the eight hours' official trial with natural draught in the stoke-holes. After the successful results on trial of all the recent cruisers and battleships, we cannot doubt but that this enormous power has been fully provided for, and that it will be developed under such circumstances as will make it quite certain that it could easily be realized at any future period in the history of the ship.

So much then for the two principal types of the navy. If it be urged that they are unnecessarily large for the services expected of them, it is for those who hold such views to point out specifically in which direction improvement may be sought, or what items at present embodied in these designs can be dispensed with without sacrificing efficiency, and while maintaining the small medium of comfort at present preserved to the officers and men. It is certain that the task of the critic is by no means an easy one. The constructive and engineering staff at the Admiralty is fortified in its practice by a mass of experience in the practical performances of the ships which they have turned out in the past, compared with which the experience of the similarly placed officials of other countries is but small, and against which the opinion of irresponsible and often ill-informed critics can be safely neglected.

The last type of vessels which claims our attention is the torpedo-boat

destroyer, and though occasionally we hear doubts expressed as to the wisdom of building vessels of this type, there has been hardly any criticism of the general features of their design.

The genesis of the small but exceedingly fast boat may be said to have commenced with the Miranda, built by Messrs. Thornycroft more than twenty-five years ago. Small as she was she attained a phenomenal speed. Following upon her performance great numbers of lightly armed swift vessels have been built for our own and for other navies. The smaller types, generally carrying a gun or torpedo armament alternatively, and adapted for keeping the sea for restricted periods only, are called torpedo-boats. The larger types carry both gun and torpedo armaments; they can keep the sea for extended periods, and owing to their considerable size it has been found possible to install machinery which gives them a decided superiority in speed over the torpedo-boats, enables space to be found for a relatively large coal supply, and gives fairly good accommodation for officers and crew; these vessels are called torpedo-boat destroyers.

The greater number of these vessels have speeds of about 30 knots. In a few of the latest boats an endeavor has been made to attain somewhat higher speeds without much increase in size, the Albatross being one of this latest type. Her dimensions will be found in the accompanying table:

	Formidable.	Drake.	Albatross.
Length	400 ft.	500 ft.	227 ft.
Breadth	75 ft.	71 ft.	21 ft. 3 in.
Mean draft	26 ft. 9 in.	26 ft.	8 ft.
Displacement	15,000 tons.	14,100 tons.	400 tons.
Horse-power	15,000 (natural draft).	30,000 (natural draft).	7500 (forced draft).
Speed	18 knots.	23 knots.	32 knots.
Coal supply (normal)	900 tons.	1250 tons.	50 tons.
" (bunkers full)	2000 tons.	2500 tons.	100 tons.
Armament	Four 12-in., Twelve 6-in. B.L. Eighteen 12-pr. Q. F. Fourteen small'r Q. F. and machine guns. Four torpedo tubes.	Two 9.2-in. Sixteen 6-in. B.L. Fourteen 12-pr. Q. F. Three 3-pr. Q. F. Two torpedo tubes.	One 12-pr. Q. F. Five 6-pr. Q. F. Two torpedo tubes.
Armor	9-in. sides. 12-in. barbette. 6-in. casemate. 2—3-in. deck.	6—2-in. sides. 5-in. casemates, 6-in. barbettes.	—

The armament consists of one 12-pounder and five 6-pounder guns, all quick-firing, and two revolving torpedo tubes capable of firing the largest pattern service torpedo. The 12-pounder gun is mounted on the conning tower; one 6-pounder is placed on an elevated pedestal on the middle line at the after end of the ship; two 6-pounders are so situated as to be able to fire directly ahead, and the others are on the broadside amidships. All these guns have exceptionally large arcs of training.

The hull structure and fittings are made as light as practicable, consistent, of course, with a due regard to durability; the better to secure this latter point, the greater portion of the material is galvanized, while to obtain the requisite strength, with the minimum of weight, steel of a specially high-grade quality is used. It is in the machinery of this vessel that the most striking evidences of enterprise are manifested. By the adoption of quick-running machinery, and water-tube boilers of the small-tube type, it has been possible to develop about 45 indicated horse-power per ton of propelling machinery for short periods.

In order that this performance may be the more thoroughly appreciated, we need only remind our readers that in large ocean-going mercantile steamers with slow-running engines and with cylindrical boilers, only about 6 indicated horse-power per ton of machinery is developed, and in modern large warships with moderately fast-running engines, and with water-tube boilers of the large-tube type, about 9 indicated horse-power per ton of machinery is obtained. Of course, these latter figures being based on the power which can be continuously developed, the comparison is not a direct one, but they enable some idea to be formed of the great disparity existing between the installation of machinery of the torpedo-boat destroyer and that of large ocean-going steamers.

What we have said about the Albatross applies pretty generally to the torpedo-boat destroyers as a class, and it reflects the greatest credit upon the Admiralty and the various builders associated with them in so successfully solving the problems connected with the production of the large fleet of these vessels which this country now possesses.—*The Engineer.*

THE FLEETS OF THE POWERS.

The number of war vessels of all kinds built or building in the various countries is as follows:

Great Britain.—Battleships, built, 53; building, 17; armored cruisers, built, 17; building, 14; protected cruisers, built, 107; building, 9; unprotected cruisers, built, 15; coast-defense vessels, armored, built, 13; special vessels, built, 3; torpedo vessels, built, 35; torpedo-boat destroyers, built, 75; building, 33; first-class torpedo-boats, built, 95; building, 2—total, 488.

France.—Battleships, built, 31; building, 4; armored cruisers, built, 8; building, 12; protected cruisers, built, 36; building, 4; unprotected cruisers, built, 14; coast-defense vessels, armored, built, 14; one special torpedo depot ship; torpedo vessels, built, 15; torpedo-boat destroyers, built, 2; building, 10; torpedo-boats, built, 219; building, 47; submarine boats, built, 3; building, 9—total, 428.

Russia.—Battleships, built, 12; building, 12; armored cruisers, built, 10; building, 2; protected cruisers, built, 3; building, 8; unprotected cruisers, built, 3; coast-defense vessels, armored, built, 15; building, 1; special vessels, built, 5; building, 2; torpedo vessels, built, 17; torpedo-boat destroyers, built, 1; building, 35; torpedo-boats, built, 174; building, 6—total, 306.

Germany.—Battleships, built, 18; building, 7; armored cruisers, built, 3; building, 2; protected cruisers, built, 13; building, 4; unprotected cruisers, built, 21; coast-defense vessels, armored, built, 11; special vessels, built, 3; torpedo vessels, built, 2; torpedo-boat destroyers, built, 1; building, 10; torpedo-boats, built, 113—total, 208.

Italy.—Battleships, built, 15; building, 4; armored cruisers, built, 3;

building, 4; protected cruisers, built, 15; building, 3; unprotected cruisers, built, 1; special vessels, built, 2; torpedo vessels, built, 15; torpedo-boat destroyers, building, 11; torpedo-boats, built, 144; building, 10—total, 227.

United States.—Battleships, built, 5; building, 11; armored cruisers, built, 2; building, 3; protected cruisers, built, 14; building, 7; unprotected cruisers, built, 6; coast-defense vessels, armored, built, 19; building, 4; one special vessel; torpedo-boat destroyers, built, 1; building, 19; torpedo-boats, built, 15; building, 14—total, 122.

Japan.—Battleships, built, 3; building, 4; armored cruisers, built, 3; building, 4; protected cruisers, built, 14; building, 2; unprotected cruisers, built, 9; coast-defense vessels, built, 4; one torpedo vessel; torpedo-boat destroyers, built, 8; building, 4; torpedo-boats, built, 29; building, 29—total, 114.—*The Engineer.*

THE UNITED STATES HARBOR-DEFENSE VESSELS.

One of the provisions of the session of Congress last year was an allowance for the construction of four harbor-defense vessels for the United States Navy. The vessels are to be of the Monitor type, and to be built after the plans furnished by the Navy Department. On October 1st bids were opened, and awards have already been made, the costs ranging from $825,000 to $875,000. Three of the ships will be built on the Atlantic coast, and one on the Pacific, and a maximum of twenty-seven months is set by the bidders for the completion of the work.

The primary purpose of the ships is for harbor-defense duty, but their sea-keeping features have been carefully considered that they may be the better fitted for rapid cruising from one port to another than the vessels of the Monitor class now in active service. In points of equipment and mechanical facilities the vessels are very decided advances upon anything of their order now in the United States Navy, and, within the reasonable scope of their powers and application, should prove very formidable fighting-machines.

A description of one ship applies equally to the others, and for example the Arkansas will be described. The ship will have a water-line length of 225 feet, the stem being carried well forward below the water and formed into an effective ram; she will have a maximum beam of 50 feet, and, upon a normal displacement of 2700 tons, will draw only 12½ feet of water. Her possible usefulness about the West Indies or in the shallow waters of the Gulf is apparent at once.

The hull is of steel, unsheathed, with an inner bottom reaching up to the armor shelf, and ranging fore and aft throughout nearly the whole length of the ship. There is the usual subdivisioning of the intramural space, as well as of the whole interior of the craft. In the double bottom, just below the boilers, feed-water will be carried, leaving just so much more room for other purposes in the boiler space. This is a departure from the service practice heretofore, and is being adopted for some of the other new ships.

The hull will be guarded by a continuous band of armor extending from the main-deck line down to a maximum depth of 30 inches below the water-line amidships, but reaching only down to the water at the stern. This armor will have a maximum thickness of 11 inches at the deck-line throughout the region occupied by the engines, the boilers, and the mag-

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azines, tapering thence to the armor-shelf well below water. Forward and abaft the vital space, the armor will be graduated by easy steps till it terminates at the bow and the stern in thicknesses of 5 inches. It is said to be the present intention of the Department to have this armor treated by the Krupp hardening process—really the Harvey process carried farther into the plate; and if this be so the defensive properties of the steel will be considerably increased—perhaps as much as 20 per cent. The protective deck, or, more properly, the main deck, will be composed of two thicknesses of ¾-inch plating, of which the upper course will be of nickel steel. This will be sufficient defense against the acute angle at which most plunging shots will have to strike. This main deck will be planked, but, being exposed to the weather, will not be fireproof.

A five-sided superstructure will occupy the central portion of the main deck. In the lower half will be quartered some of the officers, and there too will be the galley, the armory, some wash-rooms, and spare space for the housing of part of the crew if so desired. On the next deck above, i. e., the superstructure deck, will be placed the major part of the rapid-fire portion of the battery. The hammock berthing will also be in the superstructure on that deck, lending a very mild protection to the gun-crews of some of the smaller pieces. On the bridge or uppermost deck will be carried the chart-house, the boats, and all of the 6-pounder rifles. This and the deck just below, like the main deck, being exposed to the weather, will not be fireproofed; but the berth deck being under cover will be covered with linoleum placed right upon the fundamental plating. Wherever possible, woodwork has been omitted and supplanted by light metal bulwarks, etc., but where found needful for the sake of health and the saving of weight the wood used will be carefully fireproofed.

All hatch coamings are raised well above the main-deck line, and those in the open forward are carried high enough to permit of their being left open even when the deck forward is well awash with broken seas. By this means the crew space forward on the berth deck can be well lighted and comfortably ventilated when cruising in fair weather—a desideratum of prime importance when doing duty in warm southern waters. In heavy weather these hatches would be battened down, and the fresh-air supply would then be drawn down through the mast and the big ventilators, while a good deal of the foul air of the boiler spaces, especially, would be carried up between the double casings of the smoke-stack. The Monitor is not naturally a cool craft when under steam, but everything has been done in these ships that could be done to make them much more comfortable than any of their predecessors, and there is no doubt but that they will prove so. Electric fans and electrically propelled blowers will furnish most of the induced ventilation.

The ship will be driven by twin screws, actuated by two triple-expansion engines, which will be placed in one water-tight compartment. These engines will be of the vertical inverted-cylinder direct-acting type, each with a high-pressure cylinder of 17 inches, an intermediate-pressure cylinder of 26¼ inches, and a low-pressure cylinder of 40 inches, the stroke of all pistons being 2 feet. The collective indicated horse-power of the propelling and the circulating pump engines will be 2400 when the main engines are making in the neighborhood of 200 revolutions a minute. Steam will be supplied at a working pressure of 250 pounds, by four water-tube boilers, having a total grate surface of quite 200 square feet and a total heating surface of 8800 square feet, and capable of supplying all the steam on shipboard when running at full power.

The amplest possible means have been provided for a supply of cool air for the engine- and the boiler-rooms when under steam. The armored ventilator abaft the smoke-stack will be the main duct, while the two smaller ones just forward will answer the double purpose of air-shafts and ash-hoists. All of these ventilating passages will be guarded by armor gratings to keep out explosive shell, and the big, main ventilator will be surrounded by several inches of armor up to a height of 4 feet above the main-deck line.

The vessel will be lighted by electricity, while the turret mechanisms and all the ammunition hoists will be actuated by the same energy. By the adoption of electricity so general, the presence in long passages of heated steam-pipes is obviated, and in this way alone a very considerable reduction of temperature will be effected under service conditions. The main battery will consist of two 12-inch breech-loading rifles; the secondary battery will be composed of four 4-inch rifles; while the auxiliary battery will include three 6-pounders and four automatic 1-pounders. The 12-inch guns will be mounted in a single barbette turret of the balanced type, having an inclined face with a pitch of 42 degrees. The armor for the turret and the barbette will be 11 inches thick, and will be treated by the Krupp process. The total sweep, or arc, of fire of these two guns will be 300 degrees, leaving a dead angle, dead aft, of only 60 degrees, which could be easily covered by a slight swing of the ship to either side. The four 4-inch guns will be mounted on the four principal corners of the superstructure deck, where they will command an enviable field of fire. These guns will be protected by shields. The 6-pounders will be mounted on the bridge deck, while the 1-pounders will be placed on the hammock berthing amidships, and up in the single top of the military mast. The 12-inch and the 4-inch guns are to be designed for smokeless powder, and it is promised that they shall be a considerable advance upon the pieces of like caliber, of native design, now in service. For a ship of her size, the Arkansas will be a very effective fighting machine, and more than an equal, within her field of action, for any craft of like displacement. There will be a conning-tower 7½ inches thick, just below the chart-house and abaft the turret, and all means of communication will be led thence through an armored tube 3 inches thick down below the main deck.

The ship will carry two search-lights—one forward on the mast and the other on a stand at the after-end of the bridge deck. There will also be the usual outfit of electric signals and side and running lights. Modern facilities in every direction will add to the comfort and convenience of the officers and crew and to the working efficiency of the craft, and nothing will be spared that can bring the vessels typically up to date in every sense. The bunker capacity untrimmed will be 200 tons of coal, and that amount will be carried upon the normal displacement. More, of course, can be carried in an emergency, but the normal allowance at the ordinary cruising rate of speed will be amply sufficient to give the ship a considerable radius of action.

These vessels have really been called into being through the pressing needs of the growing ranks of the naval militia for proper training-schools aside from vessels temporarily detailed for such service. In many instances only the ancient Monitors of the war of the rebellion were assigned for that work, and with their old boilers and engines and muzzle-loading smooth-bore guns, they were not such drill-grounds as the modern

seaman and the volunteer officer need. With the single exception of torpedo instruction, these four harbor-defense vessels cover practically all that is needful in a general preliminary education in naval warfare of to-day, and in that capacity alone the ships will pay well for their construction.

The electric generating plant is to consist of four units, each unit to have an engine, dynamo, and combination bed-plate, and each dynamo a rated output of 400 ampères at 80 volts. This plant will supply motive energy for the ventilating blowers, and for all ammunition hoists and the mechanisms controlling the turret and the loading of the two 12-inch rifles, and power for all the lights in the ship. The complement of the ship will consist of something like 130 persons, with berthing space for a larger crew if necessary.—*The Engineer*.

OUR LATEST PROTECTED CRUISER, THE ALBANY.

The Albany in all essential points is an exact duplicate of the New Orleans, the changes which have been made in her being "such," in the language of one of our naval constructors, "as were absolutely necessary to render her habitable for Anglo-Saxons." The alterations have been chiefly in the living quarters of the officers and crew, some of them being necessary to meet the differences in climate between the tropics and our more northerly latitudes, and others being necessitated by the fact that the accommodations, sanitary and otherwise, which seemed to have sufficed for the South American republic would have been absolutely unendurable for the men of the American Navy. An improved system of ventilation has been installed, the officers' quarters have been rearranged and enlarged, and additional berthing space has been provided for the crew. Considerable alterations have also been made in the dynamo-room. These modifications have been carried through without in any way impairing the fighting efficiency of the vessel.

The Albany was launched at Newcastle, January 14, 1899. She is 330 feet in length over all, with a beam of 43 feet 9 inches, and a maximum draft of 15 feet 10 inches; and her displacement, according to figures furnished by her builders, is 3402 tons with ammunition, stores, coal and water half consumed, and with all ammunition, stores, coal and water on board, 3954 tons. She is driven by twin engines and screws; her maximum indicated horse-power is 7500, and her speed, as determined in recent trials in England under the official representative of our navy, was 20.73 knots for four hours under forced draft and 19.3 knots on a run of six consecutive hours under natural draft. The vessel is sheathed and coppered and will, therefore, be especially suited for service in tropical waters.

The Albany is thoroughly representative of the latest trend of ideas in the construction of protected cruisers. Like the best of her type she is distinguished by her good speed, generous coal capacity, considerable length in proportion to beam, enabling her lines to be carried out with great fineness and beauty, and by her powerful armament and her ability to deliver great energy of fire through a widely extended zone. In respect of defensive qualities, however, like all protected cruisers, she is certainly weak and open to attack. She is entirely devoid of vertical side armor, and her protection against the entrance of projectiles into the

vitals consists merely of a curved deck of steel assisted by coal bunkers in the wake of the engines and boilers at the water-line.

The main battery of the Albany is made up of six 6-inch and four 4.7-inch rapid-fire guns, and the secondary battery consists of ten 6-pounder rapid-fire guns, eight 1-pounders, and two Colts. The whole of the main battery is of the long 50-caliber type, manufactured by the builders of the vessel. The disposition of the battery is as follows: One 6-inch gun is carried on the forecastle deck, another aft on the poop, and four others are carried in sponsons on the main deck in the waist of the vessel, two of the latter being forward on either beam, and two aft. The sides of the vessel are cut away so as to allow these four guns on the main deck to be fired directly forward or astern parallel with the axis of the ship. The 4.7-inch guns are carried in broadsides on the main deck between the 6-inch guns. The battery of 6-pounders is carried on the main deck, forecastle and poop, two of these being in the bow, two in the waist, and two astern on the main deck, while the other four are carried on the forecastle and the poop. The vessel is provided with two military masts upon which there are no less than four separate fighting-tops in which are distributed the 1-pounders and Colts. The arrangement of the battery enables the vessel to concentrate the fire of three 6-inch guns dead ahead and astern, while the broadside fire consists of four 6-inch and two 4.7-inch guns.

The 6-inch gun of the New Orleans is carried in a trunnion sleeve or seating, in which it slides. It is held in the forward or loading position by coiled springs, inclosed in two cylinders which are attached to the seating. Attached to the gun are two pistons which travel in the cylinders, the latter being filled with glycerine, and it is the combined resistance of the springs and of this glycerine to the movement of the pistons which serves to take up the recoil. After the recoil the gun is returned to the loading position by the action of the coiled springs, which were compressed during the recoil. The breech of the gun and the crew are protected by a large shield of 4-inch Harvey steel. This type of gun has fired seven rounds in 61 seconds, and the 4.7-inch gun has a record of five rounds in 22 seconds. The 6-inch gun fires a 100-pound projectile with a muzzle velocity of 2600 foot-seconds and a muzzle energy of 4687 foot-seconds. This is equal to a penetration of 20½ inches of iron at the muzzle. The 4.7-inch guns have the same velocity, and a muzzle energy of 2109 foot-tons with a penetration of iron at the muzzle of 15½ inches. At 2500 yards the velocity of the 6-inch and 4.7-inch guns is 1790 and 1558 foot-seconds, respectively, the energy at that distance being in the 6-inch gun 2224 foot-tons, and for the 4.7-inch guns 757 foot-tons.

For protection the Albany relies mainly upon a curved deck, which is 1¼ inches on the flat and 3 inches in thickness on the slopes, the latter extending along the sides from the flat deck, which is slightly above the water-line, to a junction with the sides of the vessel several feet below the water-line. This protection is reinforced by the large coal-bunkers, which are extended along the berth deck on either side amidships, and present a horizontal thickness on each side of 8 feet of coal. The normal coal capacity is 512 tons and the bunker capacity, with full stowage, is about 800 tons.—*Scientific American.*

GERMANY'S LATEST BATTLESHIP.

The Germans, in the design of ships of their new navy, have shown marked originality, and there are some respects in which their vessels are superior to those of most other navies. The conspicuous feature is the admirable distribution which has been made of the numerous armament of the Kaiser Friedrich III. It is generally agreed among naval designers that the separate units which make up the total armament of a warship cannot be too widely separated. The terrific powers of destruction of a bursting shell make it desirable to localize its effects as far as possible, and this feature is well worked out in the German ship. The thirty-four guns in the main battery are distributed upon four decks, and the guns upon any one deck are widely separated from each other. Moreover, the guns are all carried either in complete turrets or in separate armored casemates.

Another excellent feature of the vessel is, that every gun is of the rapid-fire pattern, not even excluding the four heavy armor-piercing guns of the main battery. A third feature in which the ship is thoroughly up-to-date is the comparatively small size of the heaviest guns, the largest of which are only 9.49 inches caliber. The use of such light guns means a great saving in dead weight and a proportionate increase in the fighting qualities of the ship in the way of more speed, larger coal capacity, or a more numerous armament.

The Kaiser Friedrich III. has the moderate displacement of 11,130 tons, which is 1000 tons less than that of the Japanese battleship Fugi, over 2000 tons less than our latest battleships of the New Jersey type, and the Majestic, of the British navy, exceeds it by 3700 tons.

It is probable, however, that Germany intends to use these battleships more for coast-line defense than for foreign service. The Kaiser Friedrich III. would have to be increased in displacement by from 1200 to 1500 tons, if she were to carry the coal, ammunition, and stores sufficient for an extended service during war times in far distant waters.

The guns of this vessel are to be carried at four different stages of elevation above the water. The lowest guns are two 9.4-inch rapid-fire guns in the after turret on the main deck, and the four 5.9-inch, which are carried in casemates, two forward and two aft, on the same deck. On the spar deck above are mounted fourteen 5.9-inch guns. Six of these are carried in one-gun turrets on the broadside and eight in casemates, four forward and four aft. Forward in a turret, on the superstructure deck, and at a height of over 30 feet above the water, is the forward pair of 9.4-inch rapid-fire rifles, and, at the same elevation, on the superstructure deck, are ten 3.3-inch rapid-fire guns. Above these again, at a height of 46 feet above the water-line, on the upper bridge, is a pair of 3.3-inch rapid-fire guns. The all-around fire which is aimed at in this distribution is unusually powerful. The vessel can concentrate two 9.4-inch, eight 5.9-inch, and six 3.3-inch rapid-fire guns ahead; four 9.4-inch, nine 5.9-inch, and six 3.3-inch on either beam; and two 9.4-inch, eight 5.9-inch and four 3.3-inch astern. The armor on belt is 11¾ inches amidships, tapering to 6 inches at the ends. The main turrets carry 9¾ inches of armor and the casemates 6 inches. It will be noticed that the vessel is driven by triple screws, an arrangement which has been found to give excellent results in our own Minneapolis and Columbia.

The thick armored deck divides the vessel vertically, the most vulner-

able portion of the ship, that is, the boilers, engines, magazine and steering gear, all of which are commonly known as the "vitals," lying beneath the armored deck and below water-line. They are known as vitals because a shell bursting among them might easily put the ship out of action, and it is absolutely imperative that this portion of the vessel should be secure against attack. The thick armored belt at the water-line, the cellulose or, as in this case, cork protection, also at the water-line, the complete armored deck, and the fact that these vitals are well below the water-line render the chances of a shell entering the vitals very remote.

Above the armored deck are the guns and the living quarters for the officers and crew. At the extreme after end of the vessel are the quarters of the commander, captain or admiral. The officers' quarters are situated on the afterpart of the main deck and spar deck, while the crew's quarters are to be found on the same deck forward of the center line of the ship.

The weakest point of this type of ship is found in the scanty protection afforded to the ammunition in its passage from the magazine to the guns, and in the lack of armored protection for the bases of the turrets. In the case of a ship like our own Maine, there is a continuous wall of armor from the water-line to the top of the turrets; but in the Kaiser Friedrich III. the only connection is a small ammunition tube. In a fight at close range the endurance of the Maine would be considerably greater than that of the German ship.—*Scientific American.*

THE RECONSTRUCTED CRUISER ATLANTA.

The work of reconstruction has been very complete. The old horizontal, compound engines have been changed to triple-expansion by the addition of a high-pressure cylinder. At the same time the eight old, single-ended, Scotch boilers have been removed and replaced by two single-ended Scotch boilers and four Wilcox and Babcock water-tube boilers, the Scotch boilers carrying 180 pounds of steam and the Wilcox and Babcock 250 pounds. This change has not only greatly increased the boiler capacity, but it has reduced the bulk of the installation sufficiently to allow the construction of an athwartship coal-bunker, which will increase the total coal capacity of the vessel by 80 tons, or about 17 per cent. These changes are expected to result in an increase of the vessel's speed from 15½ to 17½ or possibly 18 knots speed.

The ship's main battery, which was formerly of the short-caliber, slow-firing type, has been entirely renovated. All of the guns, including the two 8-inch bow and stern weapons, are of the rapid-fire type, the sights being mounted upon a sleeve in which the gun recoils and the breech mechanism being brought fully up to date. Although the new 8-inch guns are not officially known in our navy as rapid-fire, they do actually possess the characteristics which mark the so-called rapid-fire guns of this size in foreign navies.

The lessons of the late war have been turned to good account in the work of reconstruction; for the Atlanta, on and above the main deck is absolutely stripped of combustible material; and if she is ever called upon to fight, there will be no fear of her being prematurely put out of action by the burning up of the wooden decks, bulkheads, and

furniture. All of this wood-work was more or less, and generally more than less, highly inflammable. In the process of refitting, the wooden bulkheads were removed and the panelings stripped from the ceiling and from the outboard turtle-back. Their place was taken by corrugated metal for the bulkheads, a coating of cork paint for the ceiling, and a covering of asbestos on the outboard walls. The wooden furniture is replaced by furniture of metal, one piece of which is a neatly designed roller-top desk. The asbestos sheathing possesses the requirements of a non-conducting, incombustible, splinter-proof covering. The asbestos fire-felt is laid over wire cloth which is attached to a framework of light angle-bar, carried between the ship's frames or bulkhead-stiffeners. The felt is flush with the surface of the frames, or the edges of the angle-bars, and asbestos millboard, three-eighths of an inch thick, is placed over the fire-felt to secure a smooth, hard finish, and it is held in position by galvanized iron moldings. The millboard is coated with sizing to prevent absorption, then painted with white enamel and striped with gold, the result being a pleasing panel effect. The asbestos sheathing has a light, cheerful appearance; it is warm in winter, cool in summer, and is free from the "sweating" which is such an insuperable objection to the use of the plain steel partition. The changes in the captain's cabin are typical of the work which has been done throughout the whole of the officers' quarters. One notable change which is conducive to convenience and cleanliness is the designing and putting in position of a folding metal berth, which in the daytime can be folded against the wall and screened by a curtain. For reasons which are only too well known to those who sleep at sea, the substitution of an open and accessible metal berth for the old, fixed wooden bunk will be greatly appreciated.

There are the new metal rifle-racks for the marines, metal lockers for the gun division, the substitution of wire screens in place of wooden bulkheads for the executive office, metal ladders and numberless other substitutions of metal for wood. On the superstructure deck the old wooden chart-house has made way for a new steel structure with circular lights.

The work above the main deck looking to the safety of the ship from fire finds its match below deck in an entirely new system of water-tight, electrically operated doors. Briefly stated, the absolutely essential elements of a successful water-tight door system are, first, that every door may be closed simultaneously and instantly from the bridge or some central station, and that some telltale announcement shall show that they are closed; secondly, that it shall be possible to raise and lower each door independently, and from either side of the door, without conflicting with the operation from the bridge; thirdly, that it shall be possible to close the door either against a rush of water or through coal which may have accumulated in the doorway. These features, with others of minor importance, are all fulfilled in the present instance. The clear opening of the door can be of any desired size; for coal-bunkers, it is generally about 4 feet 6 inches by 2 feet. The door is a steel plate riveted to a sliding frame. The guide-frame of bronze is bolted to the bulkhead, the guides being tapered one-tenth of an inch to the foot. The sliding-frame is made with eleven wedges of the same taper as the guides, there being four on each side, two on top and one on the bottom. The surfaces nearest the bulkhead of both the guide-frame and the sliding-frame are scraped surfaces which form a water-tight joint by the wedge action which oc-

curs during the last half-inch of closing. The guide-frame is open at the lower edge to prevent clogging or jamming.

The door-plate carries a bronze rack into which gears a pinion keyed to a horizontal shaft which is carried at the top of the guide-frame. This pinion engages a smaller pinion on a second horizontal shaft, at either end of which is keyed a worm-wheel, which in its turn engages a worm. The worm-shaft passes normally through the bulkhead and is driven by a one-horse power electric motor, which is carried in a watertight casing on the opposite side of the bulkhead. Crank-shafts are provided, which slip over the hexagonal end of the worm-shaft on either side of the bulkhead, and may be used for hand operation of the doors. The motor is compound-wound and of the short shunt type, the short shunt coils being relatively weak and wound outside the series coils. The circuits are so arranged that for raising the door only, the series coils are in circuit, giving a quick and easy starting; while for closing the door, where it may be necessary to cut through coal or other obstructions, the shunt and series coils are both in circuit. The current is controlled by a three-point spring lever switch on each side of the bulkhead. The switch is normally in its central position, in which the door-closing circuit may be completed from the bridge or from any central station in the ship. The door-opening circuit can be completed only at the door, and this is done by moving the lever to the right or left, operations which raise or lower the door.

The operation of this system is as follows: In case of an emergency such as a collision, the officer on the bridge can immediately close every water-tight door throughout the vessel, a small signal lamp at the bridge, or other selected station, lighting up during the movement of the door and going out as soon as the door is closed. If any of the crew should be shut in a water-tight compartment, or should it be necessary to pass from one compartment to another after the doors have been closed from the central station, all that is necessary is to turn the spring lever at the particular door, when it will open, the lever returning to the central position and closing the door automatically when the person has passed through. Mechanically considered, the door is an excellent piece of work both in design and construction. Judging from its operation as now installed on the Atlanta, it appears to admirably fulfill the requirements of a perfect water-tight door installation. We understand that Mr. Bowles's system will probably be exhibited at the Paris Exposition, where, by the way, the valuable Pollok prize is to be awarded for the best marine life-saving device submitted.

Such is the Atlanta as she will appear when leaving the navy-yard for her trial trip. The renovation and reconstruction have been so admirably planned and carried out, that except for the fact that she possesses only a partial-armored deck, this vessel will now be well up to the standard of modern cruisers of her class.—*Scientific American.*

H. M. TORPEDO-BOAT DESTROYER VIPER, WITH PARSONS TURBINES.

The Viper has been built for the British Navy, her special characteristic being that she is fitted by the Parsons Marine Steam Turbine Com-

pany, Limited, of Wallsend-on-Tyne, with the now well-known steam turbine invented by the Hon. Charles Parsons. The vessel is 210 feet long, 21 feet beam, 12 feet 9 inches depth molded, and displaces 350 tons. These dimensions differ little from those of the destroyers fitted with the ordinary reciprocating engines—the displacement is 25 tons more than the heaviest of the 30-knot boats—and it becomes interesting to note the increase in power for each successive addition to speed. The first boats of 26 knots had 3200 indicated horse-power at command, then 27 knots required an increase from 4000 to 4200 indicated horse-power. When 30-knot boats were built, it was found that the power had to be 6000 indicated horse-power; for 32 knots the power was found to be close upon 9000 indicated horse-power, and the turbine-propelled Viper has, it is said, attained her speed of 35½ knots with 11,000 indicated horse-power. In other words, the power for 26 knots was 12½ indicated horse-power per ton of displacement; for 27 knots, 15¼ indicated horse-power per ton; for 30 knots, 20 indicated horse-power per ton; for 32 knots, 24½ indicated horse-power per ton; and for 35 knots, 31½ indicated horse-power per ton. It will be noted that the increment in power, just over 30 knots, is not so great as under and over that speed, and that between 32 and 35 knots it shows a quick upward movement. The other vessels make 400 revolutions, the Viper's engines nearly three times this; and thus it was necessary, instead of having only two propellers, to fit eight on four shafts, so as to secure the necessary forward thrust and the advantages of high rotary speed.

There are two shafts on each side of the center line of the ship, with two sets of compound steam turbines. The arrangement on both starboard and port sides is that the high-pressure turbine drives the outer, and the low-pressure turbine the inner shaft. On the inner shaft a reversing turbine is also fitted; it runs idle when the boat is going ahead, and when it drives the ship sternward, the forward turbines are idle. The speed astern is 15 knots. The screw shafts are carried by brackets as usual, and on each shaft two propellers are mounted, the after having a slightly larger pitch than the forward propeller. There are thus eight propellers. The thrust from the shafts is entirely balanced by the steam acting on the turbines, so that there is little friction. The multiple propellers, and the high rotary speed, with the absence of reciprocating parts, overcomes vibrations which, apart from their wearing effect on the hull and on the personnel, render good gun-practice inaccurate. The weights are as follows:

	Tons.
Boiler-room weights with water in boilers........	100
Engine-room weights with auxiliary gear and water in condensers	52
Weight of propellers, shafting, &c................	7
Total..............................	160

The boilers are of the Yarrow type, and the auxiliary machinery and condensers are of the ordinary type. The hull and all fittings are of the usual design. The official Admiralty trials will be looked forward to with great interest.—*Engineering.*

BOILER ARRANGEMENTS OF RECENT BRITISH AND FOREIGN CRUISERS.*

By F. T. MARSHALL, Member.

Dealing with the question of boiler-room work, we find that, on the basis of the natural-draft power, the two water-tube types are substantially lighter than the cylindrical type, the Yarrow type being the lightest. On the basis of the maximum power the advantage of the Yarrow type in this respect is enormous, whereas the Belleville type is not materially lighter than the cylindrical, owing to the fact that it is not forced. Thus, on a given weight, the Belleville type will develop, with natural draft and for long periods, approximately the same power that the cylindrical type will develop for short periods of a few hours under extreme forced draft. Also, on the same weight, the Yarrow type will develop 14 per cent more than the Belleville for long periods, and 78 per cent more for short periods. Again, comparing the Yarrow with the cylindrical, it is seen that it will develop 50 per cent more power for long periods, and 65 per cent more for short periods, on a given weight.

These comparisons are based upon total boiler-room weights, including water in boilers plus water in the feed-tanks, and also such fittings as reducing-valves, separators, etc., which form an intrinsic part of the boiler systems. The separate weights of boilers and funnels, water, and boiler-room accessories are also given, and it may be noticed how relatively high the weight of accessories is in the case of the Belleville type, owing to the numerous special fittings which form part of this system.

FORCED DRAFT.

A crucial point in the above comparisons of space occupied and weight is the question of how far forced draft can safely be used in the usual exigencies of service, or even in the extreme case of war. As to the Yarrow boiler, the writer submits that, as far as the boilers are concerned, this type may safely be forced to an air pressure of, say 2 inches (the maximum employed on the Don Carlos trials) so long as the coal lasts. Working under these conditions is, however, very severe on the personnel of the stoke-holes, and the endurance of the men would probably be found to be the measure of the time during which this power could be maintained.

In the case of the cylindrical boilers a four hours' run is probably as long as these boilers could be worked at the maximum forced-draft power. These boilers have a tendency to suffer in the flame-box seams when long fire-bars are used, and it is only by the use of these long bars that the high powers looked for can be obtained. The tube ends also get choked up, especially if fitted with ferrules, and without ferrules the tubes have a great tendency to leak. It is probable that at the end of four hours the boiler efficiency will be seriously affected, and the power could not longer be maintained. On the other hand, however, the high speed obtained during these four hours might mean the salvation of the ship, and it is unfair to overlook this advantage.

It should be understood that the above remarks do not apply to forced draft applied to cylindrical boilers with moderate length of fire-bar, say

* Paper read before the Institution of Naval Architects, England.

5 feet 6 inches, and with a heating surface of 2¼ feet per indicated horse-power. Such boilers can be worked at about 17 indicated horse-power per square foot of grate continuously at sea; but their size and weight would preclude their use in the type of vessel considered, as the power obtained would only correspond approximately to the results obtained in the ½-inch air-pressure trials of warships.

Raising Steam.

The rapidity with which steam can be raised, and the ready response to sudden demands in variation of power, are two matters of utmost importance in war-vessels, and in both of these the water-tube types show a marked superiority over the cylindrical boiler. The large quantity of water contained in the latter makes it a question of hours to raise steam; and, if this operation is hurried, the boilers are strained to a serious extent, causing leakage. The same course of reasoning applies, though to a less degree, to any sudden and rapid large variation of power.

As to the two water-tube types, in both cases steam can be raised to full pressure in about thirty minutes from lighting fires. In the matter of variation of power there is also little to choose between them; for, although the large grate area of the Belleville type is an advantage, the safety with which the Yarrow type may be suddenly forced compensates for it.

Liability to Derangement in Working.

In this respect, apart from the difficulties mentioned under extreme forcing, the cylindrical type is to be preferred. All the arrangements, both of the boiler itself and of its accessories, such as the feed and steam-pipe systems, are simpler than in the water-tube types. The boilers are fewer in number, thus reducing the number of pipes and connections, and the consequent liability to leaky joints, etc. The feeding is also less critical, owing to the large water level. In addition to this, the introduction of salt water, even in considerable quantities, owing to leaky condensers or other causes, has little appreciable effect upon the working of the boilers. Although, to obtain maximum results, these boilers must be in a state of thorough repair and cleanliness, they are still serviceable after considerable neglect such as would render any water-tube type useless.

With regard to the Belleville boilers a grave objection, in the writer's opinion, is the enormous mass of mechanical detail in connection with them. Thousands of joints, all dependent upon extreme accuracy of workmanship, and many of them subject to extreme strain, due to varying temperature, are a pronounced feature in the design of this type. These points have been well met in the methods of manufacture, but most rigid supervision is required to maintain the accuracy necessary. The feeding is also extremely delicate, owing to the small quantity of water contained, and also variable weight of this water at different rates of evaporation. This latter condition necessitates the introduction of the hot-well pumps and large feed-tanks already described. The feed-regulator employed, which certainly works admirably, is, nevertheless, a delicate mechanism, and has to be kept in a high state of efficiency. The number of boilers is also great for the power developed. This large subdivision has the advantage of involving only a small reduction of power, should one boiler become inoperative for any reason; but it certainly causes an enormous addition of important detail, such as feed-pipe and steam-pipe arrange-

ments, all requiring care and attention. The furnace air-pumping engines are also an additional complication, involving many extra fittings. Whether these objections are valid, extended experience alone can show, and it is an unquestionable fact that the vessels fitted with these boilers, especially since the addition of economizers, have passed through most severe trials with consistent success.

Referring to the Yarrow type, the construction in this case is extremely simple. None of the riveted seams are in direct contact with the fire, and the strains due to changes of temperature are not severe on the parts of the boiler under pressure, especially if the outer rows of tubes are curved. The casings are probably the most severely tried part of the boilers, but no trouble need be feared from these, if carefully designed.

The great question about this and other small-tube types is the life of the tubes, owing to their comparative thinness. Any information which any gentleman could give us on this point would be of extreme interest.

The tubes of the Don Carlos, as before stated, are .128 in. and .104 in. thick for the 1⅜-in. and 1⅓-in. tubes respectively. They are galvanized externally only, as is usual for this class of boiler in the British navy. Mr. Yarrow, on the other hand, invariably galvanizes the tubes both internally and externally, but this does not appear to be necessary in the case of a boiler with drowned tubes. It is probable that one cause of wastage on the outside of the tubes is the method of steam-cleaning usually adopted in these boilers. This steam jet leaves the tubes damp, which naturally aggravates any tendency to rust. In the Don Carlos the tube-sweeping arrangement was taken from the compressed-air pipes used in connection with the armament. This gives a perfectly dry-air jet at high pressure, and proved a most efficient cleaner without the above objectionable feature. The feed-system already described has the disadvantage of a large number of pumps, but in all other respects is very simple and unlikely to become deranged. The area of water-level also is large relatively to the quantity of water in the boiler, and this area is naturally the measure of the difficulty of steady feeding.

As to the possibility of working with salt water as make-up feed, our experience has certainly been against it in both the water-tube boilers considered. A serious tendency to prime, except at very low powers, is produced by even a small admixture of sea-water, and anything approaching continuous use would be, in the writer's opinion, most undesirable. This is evidently borne out by experience, as the Admiralty have recently taken special precautions in all their vessels to minimize the risk of salt water entering the boilers through inadvertence, or without the special knowledge of the officers in charge.

Facility of Overhaul.

In this respect the Belleville type has a great advantage, viz., the readiness with which complete elements can be taken from the boiler, repaired in the stoke-hole, and replaced. The other parts of the boiler are also of small dimensions, and, in case of a serious accident, the whole boilers can be taken out of the ship through the usual air-casings without disturbing decks, etc., and with very slight derangement of even the minor fittings. The examination of the inside of the tubes, however, involves breaking and remaking a large number of joints.

As to the Yarrow type, the operation of renewing a tube is by no means difficult, although if the defective tube is in the middle of a nest, all

the tubes between it and the outer edge of the tube-plate must also be removed. The method adopted is to work the tubes from hole to hole alternately between the two tube-plates until the outer edge is reached. If, however, time is of importance, the tube ends can be plugged and steam raised again rapidly without any injury to the structure. The inside of the tubes can be readily seen through and cleaned, owing to their being straight. This examination is merely a question of minutes, and thus is likely to be more frequently made than if considerable time and trouble were needed. It also involves the breaking of no joints, except the manhole doors. The outsides of the tubes are certainly not easily examined, and it is wise from time to time to remove a tube here and there to judge of the condition of the remainder. In the case of a serious accident, or serious neglect, necessitating the retubing of a large portion of the boiler, the process would doubtless be slow. It is not a contingency likely to arise, and in any boiler would necessarily be a dockyard repair. Referring to the cylindrical boiler, the capabilities of this type for ordinary examination and overhaul are well known. For heavy repairs, however, such as renewing a furnace or flame-box, the process is both tedious and costly, and in the extreme case of removing a boiler from the ship the whole of the protective deck and superstructure in way of the boilers has to be removed.

Steam Pressure.

With the water-tube types, the pressure of 300 pounds per square inch is now customary. Such pressures are not practicable, except with water-tube boilers, without enormous increase of boiler weight, and they have the advantage of enabling smaller engines to develop the necessary powers, with the attendant advantage of relative economy at low powers. In cylindrical boilers the best balance of weight, power, and space economy appears to be obtained by using about 155 pounds steam-pressure. The additional economy in the engines, by using such higher pressures as are possible with these boilers, is not sufficient to justify the additional weight of boiler due to such higher pressures in vessels in which coal-consumption is to some extent of secondary importance.

General Conclusion.

The comparisons made appear to lead to the following general conclusions in the case of the three types of boiler considered, starting on the basis of equal space occupied:

The Belleville type is well adapted for maintaining high continuous sea speeds for long periods, and is very economical at high powers. It is comparatively light and well arranged for cleaning and overhaul. Steam can be raised quickly, and large variations in power made readily. It cannot, however, be forced, and has also the objection of great complication of detail and accessories, with consequent liability to derangement.

The Yarrow type is hardly so well adapted for continuous steaming at relatively high powers, and is not so economical under such circumstances. It can, however, be forced to almost any extent with safety, and much higher speeds obtained for considerable periods. Steam can be raised quickly, and large variations in power made readily. It is extremely light, and, being simple in detail, has small liability of derangement. Cleaning and overhaul are fairly easy, but the examination of the outside of the tubes is difficult.

COMPARISONS OF BELLEVILLE, YARROW, AND CYLINDRICAL BOILERS.

Name of Ship	Andromeda.	Hermes.	Don Carlos I.	Hai Chi.	Æolus.	Pallas.
Number and type of boiler fitted	30 Belleville.	18 Belleville.	12 Yarrow.	8 cylindrical, 4 D.-E. and 4 S.-E.	5 cylindrical, 3 D.-E. and 2 S.-E.	4 cylindrical D.-E.
Steam pressure, in pounds, per square inch	300	300	300	155	155	155
I. H. P. with natural draft*	16,500	10,000	8,000	12,000	7,000	5,000
" with forced draft	......	......	12,500	17,000	9,000	7,500
Total heating surface, in square feet	40,140	24,050	32,004	27,558	15,947	11,040
Heating surface, per I. H. P., natural draft	2.44	2.405	4.0	2.3	2.28	2.2
" " " " forced draft	......	......	2.56	1.62	1.77	1.475
Total grate area, in square feet	1,430	750	587	940	560	406
Length of fire-bars	6 ft. 3 in.	6 ft. 3 in.	7 ft. 3 in.	7 ft. 1½ in.	7 ft.	7 ft. 3 in.
I. H. P. per square foot of grate, natural draft	11.47	13.33	13.6	12.78	12.5	12.3
" " " " forced draft	......	......	21.3	18.1	16.05	18.4
Total boiler-room area, in square feet	4,925	3,100	2,440	3,470	2,230	1,900 †
I. H. P. per square foot of boiler-room area, natural draft	3.35	3.22	3.28	3.46	3.14	2.63
I. H. P. per square foot of boiler-room area, forced draft	......	......	5.12	4.9	4.03	3.94
Heating surface, per square foot of boiler-room area	8.15	7.77	13.1	7.94	7.16	5.82
Grate area per square foot of boiler-room area	.292	.242	.24	.276	.251	.214
" " " on basis 6-ft. 3-in. bars	.292	.242	.207	.242	.23	.185
Total weight of boilers, uptakes and funnels, in tons	559	342	217	447	270	174
" " of water in boilers, in tons	43	30	30	197	103	82
" " of pumps, pipes, connections, water in feed tanks, etc., in tons	168	100	82	97	55	41
Total weight in boiler-rooms, in tons	770	472	329	741	428	297
Weight in boiler-rooms in pounds, per I. H. P., natural draft	104	105.5	92.2	138	157	133
Weight in boiler-rooms in pounds, per I. H. P., forced draft	......	......	59	97.4	106.3	89
I. H. P. per ton of boiler-room w'gt, natural draft	21.4	21.19	24.5	16.2	16.4	16.8
" " " " " forced draft	......	......	38.0	22.9	21.1	25.2

* Natural draft here implies the usual Admiralty conditions, in which an air pressure of ½ in. of water column is permitted.
† Boiler-rooms very large in this vessel.

The cylindrical type is about equal to the Yarrow for continuous high-power steaming, though probably slightly less economical. At low powers, however, it is very economical. It can be moderately forced with safety, and is well adapted for ordinary cleaning and overhaul. All its arrangements are extremely simple and unlikely to become deranged. Sea water can be used in it with safety. It is, however, heavy; steam can only be raised very slowly, and large variations in power cannot be made quickly.

The foregoing conclusions, the writer submits, point to the fact that the boiler question is one which must be dealt with in its relation not only to each individual class of ship, but to each individual service. The adoption of any type will depend upon what particular qualities are most desirable for the boilers to possess to meet the special work which the vessel is designed to do. The general naval policy of any Power will thus have a direct bearing upon the question of what type of boiler is preferable for a given ship.

In conclusion it may be added that the three types considered are given merely as a comparison of actual examples of typical boilers, and are not put forward in any spirit of comparison with other types of boiler or other systems of working.—*Marine Engineering.*

COALING VESSELS AT SEA.*

Bell's requirement.—Lieutenant Bells says, "Any satisfactory plan of coaling at sea must satisfy the following requirements:—(1) Rapidity. (2) Safety. (3) Ability for the ships engaged in the operation to proceed with the minimum diminution of speed. These three requirements are absolutely essential to the success of any plan, but there are others of no little importance. (4) Necessity of keeping coal dry. (5) Minimum of labor to be employed. (6) Little cost for material necessitated."

Lieutenant Bell's plan.—In the plan suggested by Lieutenant Bell he first took the collier in tow of the warship, and then added an inclined and elevated cable attached low down to the after mast of the warship and to the top of the foremast of the collier. On this elevated line a truck or carriage was employed capable of running along this line. Two ropes are used, one fastened to the rear, and one to the front of this truck, leading the one to the warship and the other to the collier, so that the bags of coal secured to the truck can be drawn over to the warship, and the empty truck hauled back to the collier. The hawsers he used crossed from the "stern pipes of the ship of war to the bow ports, hawse ports, or other convenient places of the coal ship." He proposed to carry five bags at a time, carrying about 220 pounds of coal per bag. The bags were to be hoisted, by some arrangement, not shown, from the deck of the collier, to the suspended cable, and there attached by a man stationed on the foreyard for that purpose. With this plan he proposed to satisfy all the requirements which he had laid out—namely, rapidity, safety, etc. While he refers to the fact that his appliance costs but a trifle, he adds the following: "I would at the same time insist that no expense should be considered too great to carry out this most important,

* A paper by Mr. Spencer Miller, presented at the annual meeting of the American Society of Naval Architects and Marine Engineers.

I may say all-important, operation in those cases where it may be essential to the success or safety of any ship or ships of the navy, or any expedition they may be engaged in."

*Discussion of Lieutenant Bell's plan.**—The discussion that followed was properly very severe on Lieutenant Bell's plan, for, as it will be observed, there were no means provided for maintaining a uniform tension on this elevated and suspended wire, and if the vessels so rigged were pitching ever so little, either one of two things would occur, and probably both after a short time. By the ships pitching towards each other the coal bags would be likely to be dropped into the sea, and by pitching away from each other, either the foremast of the collier would be unshipped or the suspended cable snapped. Commander Campbell said: "I do not agree with him, but I admire his principle, and I sincerely hope this paper may help to give another blow to the 'happy-go-lucky system,' and assist us in bringing about that systematic organization of every detail for which the navy is now crying with one voice, and which is now happily receiving the special attention of our rulers." Lieutenant Tupper said, among other things: "I think the practice of coaling ships, both at sea and in harbor, ought to be made just as much a drill and evolution as are many other operations which have to be performed." The chairman of the meeting, Admiral Boys, said in relation to Bell's plan: "But if those ships should get in any seaway whatever, the operation, I believe, must break down. As to blockading, if we are to blockade, the practice of coaling at sea by boats or otherwise will occasionally be adopted."

The Low plan.—The Hon. Philip B. Low secured a patent, July 10th, 1893, on a plan practically the same as that of Lieutenant Bell, described in his paper six years earlier, but with the addition of a counterweight secured to the end of an elevated carrying cable. This counterweight was arranged to maintain a constant tension, and consequently a constant deflection on the suspended cable, regardless of the motion of the ships. The use of a counterweight to maintain a constant tension on a suspended wire rope has successfully been employed in wire-rope tramways. His plan was tested by the Navy Department in October, 1893. The test took place on board the U. S. S. San Francisco and the U. S. S. Kearsarge. The distance from the shears of the cruisers to the upright poles on the collier was about 235 feet, so that the distance between the vessels was something less than 200 feet. The transporting cable, or the transmission wire, as the inventor called it, was secured to the deck of the San Francisco, supported by a pair of shear poles at the stern, then run on an incline to a gin block near the foremast of the Kearsarge, which played the part of the collier, at an elevation of about 32 feet above the point of suspension on the San Francisco. This gave an air-line inclination from the points of support of about 8 degrees to the horizontal. After the cable was rendered about the gin block it was bent backwards, and on the end was secured a counterweight about 1600 pounds weight. The bags of coal weighed nearly 200 pounds, and the time required to travel from the pole head on the collier to the shear pole on warship was about 14 seconds. The time of hoisting and sending over ten bags of coal was about 20 minutes, giving the rate of about 2 to 2⅔ tons per hour. The Board of Naval Officers were instructed to report upon the trial, and their official report was that in rough weather the apparatus would not be

*Meeting of Royal United Service Institution, 1883.

of great value in transferring coal from one vessel to another. The apparatus was reported to have worked well; but as the sea was calm, it was impossible to tell what would have been the effect in a moderate sea. As the sea becomes heavier, the distance between ships would have to be increased for safety, and there would have to be a corresponding increase in the height of the gin block, in order that a proper inclination could be given to the connecting rope. Presuming that the distance between ships be increased to 300 feet, the same angle of inclination preserved, and the same height of shear poles on the warship, then the gin block on the collier would have to be located 70 feet above the deck of the collier. Seventy feet above the deck of the collier would take one to the truck of the foremast of the U. S. S. collier Saturn. It is clear that to attempt to attach bags of coal at such a height as that above the deck would be difficult, if not impracticable, especially in a rolling sea. Even then the capacity, whatever it might have been at 200 feet, must be something less at 300 feet distance between the ships. In order, therefore, to increase the capacity of this device, it would be necessary to increase the load; but as it will be noticed that with a 200-pound load a 1600-pound counterweight was employed, a 400-pound load would require a 3200-pound counterweight, and a 600-pound load a 4800-pound counterweight, and so on. The element of danger to the ship in carrying any such counterweight would seem to need consideration. If the tow-line should snap, this weight would be pulled up to the gin block, and then something would give away, and the dropping counterweight would do great damage.

Difficulties of coaling at sea during the Spanish-American war of 1898.—Touching upon the difficulties which were experienced by the United States vessels during the Spanish-American war, the author quotes some paragraphs which appeared in the daily press while the conflict was being waged. The *Commercial Advertiser*, On June 26th, 1898, published a diary of their correspondent located on board the United States battleship Iowa, and only that part is quoted from which has reference to the coaling problem:

"June 7th, 1898. . . . The collier Justine is alongside, and we started in coaling. The Justine has not the coaling capacity of the Merrimac, but she is a fine steamer, very strongly built. In a seaway this is a great advantage, for though we gave her some pretty hard knocks, no holes were punched in her side. Since she comes right alongside our armor belt, she can be the only sufferer. She is also very convenient to coal from. Working three forward hatches, we are able to take aboard very easily 260 tons before supper time.

"June 8th, 1898. Much to our disappointment we found that we cannot get the Justine again to-day, as she was ordered over to the Brooklyn, and we had to content ourselves with the Sterling, and to our sorrow. We had every fender out possible, big rope fellows, too, that will stand any amount of knocking, but no sooner had the Sterling come alongside than she came up heavily against our ash-chute and opened a hole in her side. There was nothing to do but send the carpenter's gang aboard and shove her off for repairs. Every one is disgusted with the Sterling for having sides like paper.

"June 11th, 1898. We tried to coal again from the Justine to-day. Made all preparations, and even started sending the coal aboard, but, before we got more than a dozen bags on, the ships knocked together again so badly that we had to cast the collier off and give it up again.

It is most aggravating, for now we must clean up the ship, only to start in coaling again on Monday."

Thus it will be seen that coaling was begun on the 7th, and on the 8th, 9th, 10th, and 11th, practically no coaling was accomplished, although each and every day they needed coal, and were desirous of having it. It may be interesting to know that this same collier Justine, after discharging a single cargo of coal, was returned to Newport News and laid up a long time for repairs, the bill for which exceeded $4000.

It is generally conceded that Cervera's defeat was due directly to the fact of being out of coal and provisions, and he thereby sought the harbor of Santiago de Cuba to fill his bunkers. It is also a fact that had he been as speedy about coaling after he had arrived, he probably could have escaped from the harbor, because the American vessels were also short of coal, as will appear from the messages exchanged between Admiral Sampson and Commodore Schley and the Navy Department, as they appeared in the report of Captain Crowninshield, Chief of Bureau of Navigation. The following message was sent from Commodore Schley to Admiral Sampson: "Arrived May 21st off Cienfuegos. . . . Expect difficulty here will be to coal from colliers in constant heavy swell. Other problem easy compared with this one so far from the base." On the same day Admiral Sampson received this despatch from Commodore Schley, dated May 24th: "Coaling off Cienfuegos is very uncertain. Having ascertained that the Spanish fleet is not here, I will move eastward to-morrow, communicating with you from Nicholas Mole; on account of short coal supply in ships, cannot blockade them if in Santiago. I shall proceed to-morrow, 25th, for Santiago, being embarrassed, however, by Texas' short coal supply and her inability to coal in open sea. I shall not be able to remain off that port on account of general short coal supply of squadron, so will proceed to the vicinity of Nicholas Mole, where the water is smooth, and I can coal Texas and other ships with what coal may remain in collier." So much has been said about this matter, it is only necessary to say that had Commodore Schley been in possession of colliers fitted to coal at sea, especially during his journey from Cienfuegos to Santiago, there would have been no occasion for his leaving Santiago unguarded a day after his arrival.

French experiments.—While the Spanish-American war was in progress the French were experimenting on this problem of coaling at sea. The Paris correspondent of the London *Times*, on July 28th, said, in reference to the experiments in coaling with the Temperley transporter, as follows: "The second interesting point in these manœuvres has been the attempt to coal at sea. This experiment, if successful, would necessarily have led to a considerable innovation in naval plans, for it would have induced the authorities to send out under the protection of men-of-war floating depots which would follow the fleets destined to fight in distant waters, and to supply them with coal. The Japon, a collier, 3000 tons, furnished with a crane—Temperley transporter—while steaming six knots in a rough sea and strong breeze, succeeded in coaling the Marceau and La Touche Treville with 200 tons of coal. It was a successful beginning, but the operation was not continued as long as desired, it being interrupted in the case of the Marceau by way of precaution, and in the case of La Touche Treville on account of an accident to the Japon, which had to return to Toulon for repairs." This problem does not seem to have been fully solved, as proved by the damage sustained by the Japon. The French Admiralty "is confident of a decisive result, for it has just decided

that the Japon is to remain permanently attached to the Mediterranean reserve squadron. This solution will naturally have important consequences, one of the first being eventually the complete revictualing of ships in motion, or at any rate out at sea. There is no doubt, indeed, that, the question being thus raised for all navies of the world, it will be solved. We may even go further. If all the nations could have not merely coaling stations but complete revictualing stations always at hand, victualing on the voyage would be neither necessary nor useful. This, however, is impossible, even for the richest and best equipped powers, especially now-a-days, when colonizing nations may be drawn into action in far distant regions. It may therefore be supposed that the problem to be laid down will be coaling and revictualing in motion." "This is the question now before all the great navies, and as such experiments cannot be made in the dark, it is certain that all nations will almost simultaneously have the necessary apparatus for enabling ships to be supplied at sea, so that they can be sent to the greatest distance without running short, at the moment of combat, of either food or coal."

Coal supply: Vice-Admiral Colomb, R. N.—A number of interesting reviews of the Spanish-American war were made by foreign naval officers. One of the most interesting touching the subject of coal supply was written by the late Vice-Admiral P. H. Colomb., R. N., in *Cassier's Magazine*, published August, 1898, entitled "Coal Supply, Speed, Guns, and Torpedoes in Marine Naval War." Among other things under the head of coal supply, Vice-Admiral Colomb said: "We get speed and certainty for voyages made under steam, and the full advantages are reaped in peace time, because coal supply can be exactly arranged for and calculated according to the work required of it, for that can be known, but for the warships in war no such special arrangements and calculations are possible. Coal supply can be treated only generally before war breaks out. No one can say beforehand whether it has been advantageously or economically allotted."

Becoming interested in this question in 1893, the author proposed at that time to stretch an elevated cable from the stern of the warship to the bow of the collier in tow, one to be securely fastened to the warship and the other end wound around the compensating engine, similar to the steam-towing machine. The load running on this cable was to be conveyed over by an endless rope. It was expected that the compensating engine would keep an equal strain on this elevated line irrespective of the pitch of the vessels so connected. In March, 1898, Lieutenant J. J. Woodward, Naval Constructor, located at Newport News, Va., invited plans and prices on a device containing much the same general ideas. A few weeks later—April—a plan was sent to Mr. Woodward, and he in turn transmitted it, with favorable recommendations, through the Chief Constructor, to the Secretary of the Navy. It was not, however, until August of the same year that any understanding was had with the Navy Department whereby the work of construction could be begun. The plan, considerably modified, was submitted to a Board of Naval Officers, consisting of Rear-Admiral Ramsay, president, Thomas Williamson, chief engineer, and Z. L. Tanner, commander, and they consider the device "feasible in moderate weather." Thereupon the Department contracted with the Lidgerwood Manufacturing Company, of New York City, U. S. A., to have the apparatus installed on board the collier Marcellus. So much time was lost in negotiations, however, that before the work of construction was begun the war came to an end.

The author's experiments.—October 15th, the author performed an experiment in New York harbor with a tug, towing a sloop, using a quarter-sized model. Shear poles were mounted on the tug, and blocks on the mast of the sloop, the distance between points of support being 100 feet. An endless rope was employed, being used in accordance with the plan shown in Fig. 1. A movable sheave in the bight of the cable aft the mast was held taut by a line connecting it with a sea anchor or towing cone dragged in the sea behind the sloop. By this plan it will be observed that the tug towed the sea anchor as well as the sloop, the latter merely supporting the rope as it passed over. A carriage gripped to the upper part and provided with wheels to roll on the lower part served to carry the bags of coal over from sloop to tug. As the experiment was performed in a storm, no photographs were taken. The storm was so severe that the sloop shipped water over the bow, and both boats rolled and pitched very badly. In spite of this, however, the bags of coal were conveyed across the space as though the sea was smooth; the sea anchor serving to perfectly act as a compensator, maintaining a constant tension on the endless conveying cable. If such a plan were adopted, the sea anchor would have to be selected in accordance with the speed of towing; the greater the speed the smaller the cone required.

Description of the Miller Conveyor on the U. S. S. Marcellus.

(1) It is proposed, with this device, for the warship to take the collier in tow, or the collier to tow the warship, leaving the distance between ships about 300 feet; this method of securing boats at sea is recognized as being safe.

(2) The warship to receive the coal will erect a pair of shear poles on its deck, which, secured by guys, will support a sheave wheel and a chute to receive the load.

(3) The collier is provided with a specially contrived engine located aft the foremast, having two winding drums. A steel cable, ¾-inch diameter, leads from one drum to the top of the foremast, over a sheave, thence to the sheave on the warship, back to another sheave on the top of the foremast, thence to the other drum. This engine gives a reciprocating motion to the conveying rope, paying out one part under tension; a carriage secured to one of the parts passes to and from the warship, its load clearing the water intervening.

(4) A carriage of special form is provided with wheels which roll on the lower part to the conveying cable, and grip slightly but sufficiently the upper part of the cable. This carriage will carry bags of coal 700 pounds to 1000 pounds. The load is held by a hook pivoted at the bottom of the carriage, which hook is held by a latch. When the carriage comes in contact with the rubber buffer on the sheave block at the warship, this latch is pressed in, thereby releasing the hook and its load. Should the carriage strike heavily at either terminus the upper part of the cable will slip through the grip and no damage will be done.

(5) As soon as the bags are dropped, the direction of the rope is reversed, and the carriage returned to the collier. During the transit of the load an elevator car descends to the deck, bags of coal placed thereon, suspended from a bale, and elevated again to the stops on the guides, so that when the carriage has returned to the collier, the pointed hook finds its way under the bail or hanger supporting the coal bags. The instant the load is hooked on, the direction of the ropes is again reversed, the

carriage takes its load from the elevator and transfers it across the intervening space to the warship, and drops it again into the chute.

(6) The engine for operating the conveyor is of peculiar construction. It runs practically all the time in one direction, its speed being varied by the use of the throttle. The drum near the foremast is provided with friction mechanism so that it is capable of giving to the rope a tension anywhere from 1000 pounds to 4000 pounds. This drum is operated by a

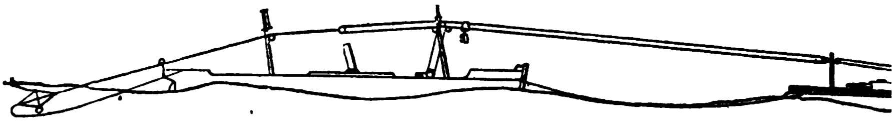


FIG. 1. MILLER'S EXPERIMENTS, 1898.

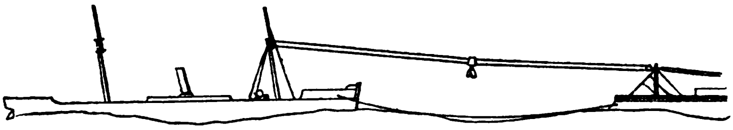


FIG. 2. MILLER CONVEYOR, 1899.

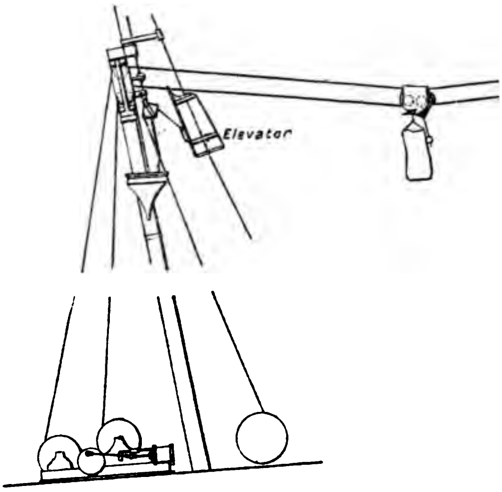


FIG. 3. DETAILS.

lever. The other drum is of special form, employing two dry metallic surfaces in contact. This drum is adjusted so that it will slip under any strain exceeding, say, 3000 pounds. It may be adjusted while the operation is going on, the tension being increased if the load sags too much, and diminished if the deflection is unnecessarily small. The forward drum will be referred to hereafter as the 4000-pound drum, and the other as the 3000-pound drum. When the engine is running, the tendency of both drums is to draw both parts in, one to the extent of 4000 pounds and

the other 3000 pounds. The effect, therefore, is for the 4000-pound drum to prevail and overhaul the 3000-pound resistance, and it is this resistance that sustains the load in its transit between the two boats. Through the co-operation of the two drums the conveying distance between the two boats is compensated for, and a practically uniform tension sustained during the transit of the load. If the points of support on the two ships approach each other—during the transit of the load—the effect will be that the drum pulling 4000 pounds will take up the slack so produced, and the 3000-pound drum will temporarily cease slipping, or at least the slip will be reduced. If now the boats pull apart, the 3000-pound drum will simply slip the faster. All that is necessary, therefore, in the operation of this machine is to see to it that the speed of transit is in excess of double the speed at which the two boats come together.

(7) After the load is dumped at the warship the operator of the engine releases the friction lever on the 4000-pound drum, thus reducing the tension on the lower part to some point considerably below 3000 pounds, whereupon the 3000-pound drum acts to haul in rope, and thus returns the carriage to the collier.

(8) The speed of conveying is about 1000 per minute, consequently the load will be taken from the collier and deposited in the warship in about twenty seconds.

(9) Attention is called to the fact that the total tension on these two parts of rope will never exceed, say 8000 pounds; furthermore, should the ships pull away from each other and the tow line part, the only effect will be to unwind the rope from one of the drums, its end falling into the water, whereupon the other drum will wind in the other end of the rope and recover the carriage attached thereto. The drum used for operating the conveyor also serves to wind up and store the cable when the collier is not coaling at sea.—*The Engineer.*

COALING VESSELS AT SEA.

At the recent meeting of the Society of Naval Architects and Marine Engineers, a paper was read by Spencer Miller on methods of coaling warships at sea, in which the apparatus he had designed was explained. Our readers will recall the abstract of his paper published in the report of the meeting. Since that time further experiments have been carried out by the Navy Department, using this apparatus at sea off Sandy Hook, the collier Marcellus and battleship Massachusetts taking part in the trials. They were at a distance of from 300 to 400 feet apart, depending on the condition of the sea. On the collier there was mounted an engine with two drums or reels; a small wire rope, ¾-inch diameter was led from one drum or reel to a sheave at the top of the foremast and thence across to a sheave mounted above the quarter deck of the warship, returning by a parallel route to another drum or reel. A load carriage of novel design gripped the upper branch of this elevated rope, and was forced to travel by the reciprocating motion of the rope to and from the warship. From the carriage were suspended two bags of coal weighing 840 pounds, and by disengaging gear these were dropped into a canvas chute over the quarter deck of the warship at the rate of one load per minute, or from 20 to 25 tons per hour. The rope was operated by one drum or reel winding in one end of the rope, while the other drum or

Royal Lifeboat Institution has been working on this problem for several years, with doubtful success, having built several steam lifeboats; * but in the opinion of many the mistake has been made of building their boats too large, they being, in fact, seagoing tugs. The lifeboats of the U. S. Service are made self-righting, as they are used in surf which can, and frequently has, capsized them. A boat with steam-power, if capsized and rolled completely over, would have but little assistance from its engine afterwards. Experiments have recently been made by the U. S. Life-Saving Service with a gas engine as the motive power, and with very gratifying results. The Service 34-foot lifeboat was selected, the largest class in use, and in this a 12 H. P. "Superior" gas engine was placed. This engine was selected because of its lightness per horse-power, simplicity of construction, compactness, and its ability to run under adverse conditions. It is also arranged to turn two propellers with one engine.

The engine, with the gears and attachments of the two propeller shafts, is installed wholly within the after air-chamber, the only portion of the machine on the outside being the two reversing levers, the end of the starting shaft, and the oil cups. The parts outside of the air-chamber are in recesses in the bulkhead, out of the reach of ropes or other dangers, as shown in the accompanying drawing. The engine was installed without disturbing the construction of the boat. It was passed through an opening 16 inches by 16 inches, and set up on the inside. The air-chamber is 6 feet long and 6 feet wide at the gunwale of the boat, tapering to a few inches at the keelson and stern-post. The engine weighs 1350 pounds, is of the two-cylinder type, having an explosion every revolution, the spark being produced by sixteen portable rubber-cell batteries. The engine cylinders are 6 inches by 6 inches, and the speed of revolution is 400 turns a minute.

There are two 18-inch propellers, having two reversible blades each, the reversing levers being connected to pulls leading through stuffing-boxes in the bulkhead. The propellers are protected on the outside by suitable cages. The cylinders are lubricated by automatic oil pumps, and all other bearings by cups placed in a recess in the bulkhead, and accessible from the outside.

Air is supplied to the engine through two 2½-inch brass pipes leading from the top of the inside of the air-chamber, down the bulkhead, and opening through it 6 inches from the deck. If the boat should be upset, these openings will be in the air space under the boat, and out of the reach of the water.

Gasoline is stored in the forward air-chamber and as high as the roof will allow, the gasoline being carried to the engine by gravity, dispensing with the pumps and their different parts so apt to become clogged and fail at a critical moment. The tank in the boat under trial has a capacity of 75 gallons, though there is room in the air-chamber to carry a much larger tank if necessary. To prevent the fuel from being cut off from the engine by reason of the extreme pitching of the boat, as might occur in a very heavy surf when the stern is on a high sea, a small reservoir is attached to the engine through which the gasoline flows to the engine. The engine consumes 2 gallons of gasoline an hour when under the full speed of 7½ miles per hour, at an expense of about two cents an hour per horse-power.

*An illustrated description of a hydraulic propelled lifeboat was published in the issue of January, 1898, of Marine Egineering.

The batteries are sealed, and carried in a drawer fitting into a close case in the forward air-chamber, having its only opening in the bulkhead By this arrangement the batteries must be removed from the air-chamber for any needed attention, thus removing all danger of accident from a spark caused by ignorant handling of the wires.

Provision has been made for cutting off the supply of fuel from the engine in case of a capsize, thus stopping the engine. This is advisable, for without this precaution, if the lifeboat was upset, and the crew thrown into the water, the boat would right almost instantly, and, the engine being in motion, would run away from the crew before they could climb into the boat. Another reason for stopping the engine during an upset is the danger from having the passengers and crew thrown into the water with the two propellers running at a high speed in the vicinity. The self-righting qualities of the lifeboat have not been injured by the addition of the weight of the engine. In the tests made she righted from even trim, bottom up, to even trim, right side up, in 3 seconds.

In these tests the boat attained a speed of 7½ miles an hour over a measured course. She reversed from full speed ahead and had sternway on in 20 seconds. With one propeller going ahead and the other astern, she turned in a circle 50 feet diameter. The boat was tested under sail and power during a gale blowing at the rate of from 28 to 40 miles an hour, as registered at the Weather Bureau. She was taken 5 miles outside of the harbor of Marqette, Mich., and tried under all directions of wind and sea, and behaved as well as could be desired. Under the same conditions of wind, and without the engine, a tugboat's assistance would have been necessary, or several hours consumed in beating the lifeboat out against the wind.

It is the unanimous opinion of the officers of the Service who have witnessed the trials of this boat that the Service would have a very valuable auxiliary by its general adoption.

U. S. S. BAILEY.

The torpedo-boat destroyer Bailey was launched into the Harlem river from the yard of the Gas Engine & Power Co., and Charles L. Seabury & Co., Consolidated, New York City, on December 5. The boat was christened by Miss Florence Beekman Bailey, grand-daughter of the late Rear-Admiral Theodorus Bailey after whom the boat was named. An artistic silver loving-cup is to be presented by the family of Rear-Admiral Bailey, upon which a suitable inscription referring to the services of the Rear-Admiral under Admiral Farragut will be engraved. The Bailey is one of the three boats authorized by act of Congress of March 3, 1897. She has hitherto been classed as a torpedo-boat destroyer, but is now placed in the list of torpedo-boats of the navy. The other two vessels authorized under this act are the Goldsborough, building at Portland, Ore., and the Stringham, which was launched some time ago in Wilmington, Del. The Bailey is of the following dimensions: Length, 205 feet; beam, 19 feet 2 inches; mean draft, 6 feet; displacement, 235 tons. She is fitted with twin screws, driven by triple-expansion engines of the builder's design, which are expected to develop 5600 horse-power. Her estimated trial speed is 30 knots. The armament of the boat will consist of

DIMENSIONS, &c., OF VICKERS' 3-INCH (50 CALIBERS) NAVAL AUTOMATIC GUN.

Diameter of bore	3 inches.
Length of bore	150 "
Total length of gun	161.95 "
Diameter of chamber	3.01 "
Length of chamber	27.76 "
Maximum pressure in chamber	16.5 tons.
Weight of charge	3 lbs. 2.5 oz.
Total weight of gun, including breech mechanism	17 cwt. 2 qr. 20 lb.
Muzzle velocity	2650 foot-seconds.
Muzzle energy	681 foot-tons.
Perforation of wrought-iron plate at muzzle by Gavre formula	10.2 inches.
Perforation of steel plate at muzzle by Gavre formula	7.9 "
Rounds per minute	26
Weight of mounting complete with shield	18 cwt. 0 qr. 21 lb.
Weight of shield	2 cwt. 1 qr. 9 lb.
Angle of elevation	20 degrees.
Angle of depression	15 "

Turning now to the special detail of the gun, the firing and breech mechanism, in rear of the cradle there is a pistol-grip, which contains the trigger, and on the right-hand side there is a detachable lever, by the movement of which the breech-block can be lowered or raised. Situated between the buffers underneath the cradle there is a powerful flat spring, the action of which works the breech mechanism. To prepare the gun for firing its initial round, the breech is opened by the movement of the hand-lever, the handle of which is made to rest in a crutch prepared for its reception at the side of the gun. By the movement of the hand-lever a crank is turned. The action of the crank brings down the breech-block, and compresses the powerful flat spring situated between the buffers. At the same time, the pivot on the crank-arm presses down the cocking-lever, thus pulling the striker to the rear and compressing the main-spring. These parts are then kept in position by the action of the sear. The breech-block, in moving down, strikes the lower extension of the extractor and causes the upper portion to move out from the face of the end of the barrel and brings two small projections over the upper edge of the breech-block, thus preventing it from rising by the reaction of the spring.

In this state the gun is ready for acting automatically. The operator has to slide the cartridge by a smart action into the bore. As it goes forward into the chamber, its rim strikes against the extractor and forces back the projections which prevented the breech-block from rising. This is practically the only hand movement in an otherwise completely automatic device. The flat spring already referred to, then acts and rotates the crank, thus raising the block until the breech is closed. The tail end of the sear is now engaged with the toe of the trigger, and by drawing the trigger-pull to the rear the trigger releases the sear, and the firing-pin is thrown forward by the action of the mainspring, which extends across the gun.

The recoil of the gun in the cradle, upon firing, is controlled by the hydraulic buffers already mentioned, and compresses the powerful springs round the piston-rods. The reaction of these springs at once returns the gun into its original position in the cradle. As the gun returns it so acts upon the breech mechanism as to cause the crank to rotate or fall, and

thereby it brings down the breech-block. The extractor is actuated by the fall of the block; it first loosens the cartridge by a slow movement, which, rapidly increasing, finally ejects it to the rear.

The gun is now ready for another round. The cartridge is placed in the gun as already described, when the breech closes and is secured automatically. The rounds are fired by pulling the trigger when required, and, as we have said, 26 rounds may be fired per minute.

The gun is mounted on a cone with cross-head and pivot. The elevation and direction of the gun are controlled by the man laying the gun, who stands with his shoulder pressed against the shoulder-piece, the maximum angle of elevation of the gun being 20 degrees, and of depression 15 degrees. In this way, and with his right hand on the pistol-grip, the gunner has full power over the movements of the gun.—*Engineering.*

THE ARMAMENT OF OUR LATEST WARSHIPS.

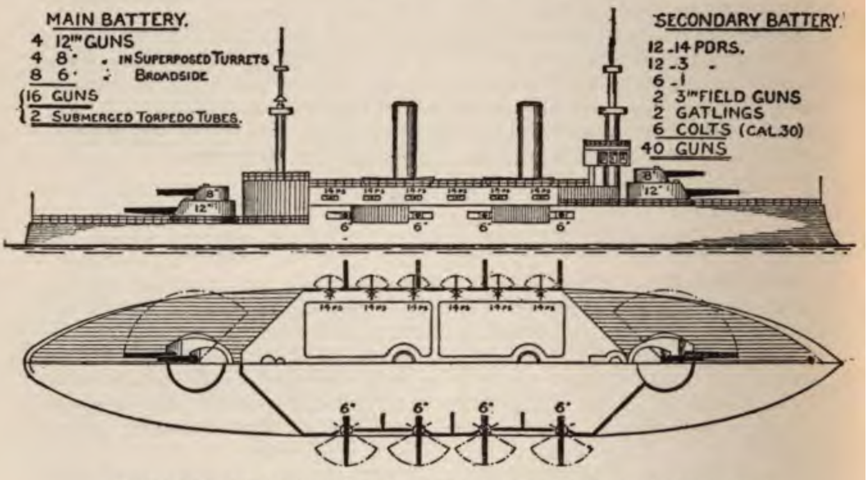
We present illustrations of our latest long-caliber guns, and also of the proposed armaments of the three first-class battleships, New Jersey, Georgia and Pennsylvania, authorized by the last Congress. In the last report of Rear-Admiral O'Neil, Chief of the Bureau of Ordnance, reference was made to the new ordnance which is being constructed for the batteries of future warships. These guns are to use smokeless powder, and develop vastly greater energy, gun for gun, than the old brown-powder guns, which were so largely in use during the war with Spain.

The explanation of the remarkable changes in our navy guns, as shown in the accompanying comparison of various patterns in use during the past fifteen years, is to be found chiefly in the qualities of the powder. The old black powder of the civil war was a quick powder—the charge being almost instantly converted into gas at the instant of firing; the brown powder used in the Spanish war was slower-burning than the black powder, but quicker than the smokeless powder, which burns, for an explosive, at a very slow rate, and gives off enormous volumes of gas. The slow combustion of smokeless powder necessitated a longer bore, to give the powder time to be completely consumed, and it is by the large powder-chamber, big charge, slow combustion and sustained acceleration in the long bore, that the modern long-caliber gun achieves its wonderful results, the projectile of the new 6-inch gun leaving the muzzle with a velocity of 2900 feet per second.

The accompanying diagram shows four patterns, from the 30-caliber 4.8-ton brown-powder gun, as originally carried by our earlier ships, to the new 50-caliber smokeless-powder weapon, which is to be mounted on the New Jersey. The earlier gun of 1883 was 16 feet 3 inches long and fired a 100-pound projectile with a muzzle velocity of 2000 feet per second and a muzzle energy of 2773 foot-tons. Following this came the 35-caliber 5.2-ton gun, which was 18 feet 8 inches long, and gave a muzzle velocity of 2080 foot-seconds and a muzzle energy of 2990 foot-tons. This is the gun originally mounted on the Oregon and class, but since replaced by the 40-caliber rapid-fire gun, which is 21 feet 3 inches long, and has a muzzle velocity of 2150 foot-seconds, and a muzzle energy of 3204 foot-tons if fired with brown powder. The 50-caliber gun is 25 feet long, and when using the new smokeless powder it will develop a muzzle velocity of 2900 foot-seconds and a muzzle energy of 5838 foot-tons, which

is more than double that of the earlier, 30-caliber 6-inch brown-powder guns of the Boston and Atlanta.

A study of the diagrams shows that the construction of our guns has been greatly simplified by the reduction of the total number of parts of which they are composed. The 30-caliber gun consisted of twelve sepa-



ARMAMENT AND $\frac{2}{3}$ AMMUNITION 951 TONS—7.03 PER CENT OF 13,500 TONS.

COMPARISON OF FOUR PATTERNS OF 6-INCH GUN FROM 1883 TO 1899.

rate pieces, whereas the new 50-caliber piece, although weighing nearly twice as much, contains only half that number. The difference is due chiefly to the improvements which have taken place in the manufacture of gun-steel, assisted by the experience which has been gained in the assembling of built-up guns. The Ordnance Bureau of the navy has al-

ways claimed that it could build as efficient a gun on the built-up or hooped system as could be secured under the wire-wound system, which finds great favor in the British navy; and the behavior of our guns, coupled with the high ballistic results achieved with the latest gun, proves that their confidence was not misplaced.

The built-up gun of 1883 consisted of an inner tube extending from breech to muzzle; a jacket and a set of chase-hoops shrunk on over the tube; and a set of jacket-hoops shrunk on over the jacket, while over these was a ring carrying the trunnions. In the 40-caliber gun, the many chase-hoops have given place to one long hoop or two, while in the 50-caliber weapon the construction is simplified to an inner tube, a single, long jacket and three jacket-hoops. The substitution of a long jacket and a few long hoops for the many short hoops of the 30-caliber gun not only cheapens construction but adds greatly to the transverse strength of the piece.

NAVAL GUNS (MODELS OF 1899).—PERFORATION OF FACE-HARDENED ARMOR WITH SMOKELESS POWDER AND UNCAPPED* PROJECTILES.

Caliber.	Length in Calibers.	Weight in Tons.	Projectile in Pounds.	Muzzle velocity. Foot-seconds.	Muzzle energy. Foot-tons.	Perforation at muzzle, Harveyed nickel-steel in Ins.	Perforation at muzzle, Krupp armor in Inches.	Remaining velocity at 3,000 yards. Foot-seconds.	Perforation at 3,000 yards of Harvey armor in Inches.	Perforation at 3,000 yards, Krupp armor in Inches.
3-inch	50	0.87	14	3,000	874	4.19	3.35	1,401	1.52	1.22
4-inch	50	2.56	32	3,000	1,999	6.11	4.90	1,690	2.85	2.28
5-inch	50	4.46	60	2,900	3,503	7.51	6.01	1,771	3.89	3.11
6-inch	50	8.0	100	2,900	5,838	9.35	7.71	1,893	5.30	4.24
7-inch	† ..	...	...	....	.....	.....	.....	.....	.....	....
8-inch	45	18.0	250	2,800	13,602	13.57	10.66	2,068	9.06	6.61
10-inch	40	33.4	500	2,800	27,204	18.57	14.86	2,209	13.53	10.82
12-inch	40	52.0	850	2,800	46,246	23.42	18.74	2,291	17.92	14.34

* With capped projectiles an increased thickness of from 15 to 20 per cent can be perforated. † Design not yet completed.

The accompanying table shows the ballistics of the new naval guns (1899 model). They are all built according to the improved principles shown in the 6-inch 50-caliber gun, and it is safe to say that as they stand on paper the results are generally equal, if not superior, to those obtained in foreign navies. The 14-pounder, 3-inch gun will form a conspicuous feature in the armament of our future ships. While by its rapidity of fire it will be suited, like the 6-pounder which it displaces, to repelling torpedo-boat attack, its power and range will render it very effective against the unarmored and lightly armored portions of an enemy's ship. The 4-inch gun will be mounted on our gunboats, while the 5-inch and 6-inch guns (chiefly the latter) will be used in the secondary batteries

of our warships and cruisers. The 8-inch, and possibly the 10-inch, will be used for the main battery of our cruisers, and the 12-inch weapon will be the main fighting element of our battleships, although, if we follow the latest trend abroad, we may discard the 12-inch in favor of the 10-inch gun. The 12-inch gun is the most powerful weapon of its caliber afloat to-day, its muzzle energy of 46,246 foot-tons being only surpassed by the 16- and 17-inch Armstrong guns of the British and Italian navies, which have a muzzle energy of 54,000 and 55,000 foot-tons. The penetration of our gun, however, is considerably greater.

The accompanying diagram represents proposed design for arming the 13,500-ton battleships of the New Jersey class, the guns to be of the new 1899 model. It is drawn up by the Bureau of Ordnance, and the amount of weight apportioned to armament is based upon the design of the Maine, in which the weight of armament and ⅔ ammunition was 1100 tons, or 8.8 per cent of the trial displacement of 12,500 tons. The design calls for the superposed turret, and is really an improved Kearsarge, the improvements consisting of 2 knots more speed, a lofty spar-deck, and the substitution of eight 6-inch, twelve 3-inch guns and twelve 3-pounders for fifteen 5-inch and twenty 6-pounders—a great increase in fighting qualities, especially if the up-to-date character of the guns is borne in mind.

This design is most powerful, and if the gunnery trials of the Kearsarge are satisfactory, it is likely to be adopted.

An excellent feature in these ships is the recessed gun-ports of the secondary battery, which allow the long 50-caliber guns to be swung round, muzzle to muzzle, against the ship's side, when they are not in use. This is particularly desirable when the vessels are in harbor, or moored at a dock, the long projecting chase of a modern rifle being liable to injury from passing vessels or from cranes or other obstructions at a dockyard.—*Scientific American.*

THE NEW SMOKELESS-POWDER GUNS OF THE UNITED STATES NAVY.

If one were asked to name the most important among the elements which go to make up the modern fighting-ship, preference would have to be given to the armament; for it is certain that, whatever else a fighting-ship may or may not have, she must carry guns, and plenty of them, if she is to be true to her name. The supremacy of the gun in modern warfare was suggested, if not proved, by the excellent results obtained with our extemporized warships in the way of converted merchant steamers, yachts, and tugs, which rendered such a good account of themselves in the Spanish war. Moreover, if our guns are to be fully effective against an enemy whose ability to manœuvre his ships and handle his guns is supposedly equal to our own, there must be no deficiency on our side as far as the weapons themselves are concerned; they must be able to shoot as fast, as far, and as true.

The Bureau of Ordnance of the United States Navy is to be congratulated on the fact that it has always maintained the ordnance which is carried by our ships at the same high level, if not somewhat in advance, of the efficiency of the ships themselves. In the days of brown, smoke-producing powder, the guns of the United States Navy were fully equal

TABLE I.

ELEMENTS OF NAVAL GUNS, GIVING PERFORATION OF FACE-HARDENED ARMOR, AT RANGES UP TO 3,000 YARDS, WITH SMOKELESS POWDER AND UNCAPPED ARMOR-PIERCING PROJECTILES, AT NORMAL IMPACT.

Calibers of guns.	Length.	Weight.	Weight of projectile.	Muzzle velocity.	Muzzle energy.	Perforation at muzzle, Harveyed nickel-steel.	Perforation at muzzle, Krupp armor.	Remaining velocity at 1,000 yards.	Remaining velocity at 3,000 yards.	Perforation at 3,000 yards of Harveyed nickel-steel.	Perforation at 3,000 yards of Krupp armor.
	Calibers.	Tons.	Pounds.	Foot-secs.	Foot-tons.	Inches.	Inches.	Foot-secs.	Foot-secs.	Inches.	Inches.
4-inch ..	40	1.5	33	2,200	1,107	4.05	3.24	1,817	1,245	1.88	1.50
5-inch ..	40	3.1	50	2,650	2,434	5.90	4.72	2,175	1,466	2.68	2.14
6-inch ..	40	6.0	100	2,550	4,507	7.88	6.30	2,212	1,665	4.46	3.65
8-inch ..	35	13.1	250	2,300	9,168	10.44	8.35	2,079	1,698	6.97	5.58
10-inch ..	30	25.7	500	2,200	16,775	13.46	10.77	2,033	1,736	9.81	7.85
12-inch ..	35	45.2	850	2,300	31,170	18.02	14.42	2,151	1,882	13.79	11.03
13-inch ..	35	60.5	1,100	2,300	40,338	20.28	16.22	2,164	1,917	15.91	12.73

NOTE.—With capped projectiles an increased thickness of from 15 to 20 per cent may be perforated.

TABLE II.

TYPES OF NAVAL GUNS (MODELS OF 1899), GIVING PERFORATION OF FACE-HARDENED ARMOR, AT RANGES UP TO 3,000 YARDS, WITH SMOKELESS POWDER AND UNCAPPED ARMOR-PIERCING PROJECTILES, AT NORMAL IMPACT.

Calibers of guns.	Length.	Weight.	Weight of projectile.	Muzzle velocity.	Muzzle energy.	Perforation at muzzle, Harveyed nickel-steel.	Perforation at muzzle, Krupp armor.	Remaining velocity at 1,000 yards.	Remaining velocity at 3,000 yards.	Perforation at 3,000 yards of Harveyed nickel-steel.	Perforation at 3,000 yards of Krupp armor.
	Calibers.	Tons.	Pounds.	Foot-secs.	Foot-tons.	Inches.	Inches.	Foot-secs.	Foot-secs.	Inches.	Inches.
3-inch ..	50	0.87	14	3,000	874	4.19	3.35	2,328	1,401	1.52	1.22
4-inch ..	50	2.56	32	3,000	1,999	6.12	4.90	2,477	1,690	2.85	2.28
5-inch ..	50	4.46	60	2,900	3,503	7.51	6.01	2,460	1,771	3.89	3.11
6-inch ..	50	8.00	100	2,900	5,838	9.35	7.71	2,516	1,898	5.30	4.24
8-inch ..	45	18.00	250	2,800	13,602	13.57	10.66	2,531	2,068	9.06	6.61
10-inch ..	40	33.40	500	2,800	27,204	18.57	14.86	2,587	2,209	13.53	10.82
12-inch ..	40	52.00	850	2,800	46,246	23.42	18.74	2,619	2,291	17.92	14.34

NOTE.—With capped projectiles an increased thickness of from 15 to 20 per cent may be perforated.

to those in use abroad; and the weapons which have been designed and are now being manufactured at Washington to meet the requirements of the new smokeless powder, will be superior to those which are mounted in foreign navies; thus placing us for the first time in the lead in the matter of ordnance.

By the courtesy of Rear-Admiral O'Neil, we are enabled to present the two accompanying tables showing the ballistic qualities, both of our old guns built in the days of brown powder, and of the new guns of exceptionally long caliber which have been constructed specially to meet the requirements of smokeless powder. The guns given in Table I represent the patterns built between 1883 and 1888, before the era of smokeless powder, when the brown powder was the only kind used in our navy. It will be seen that the length of the guns ranged from 30 calibers in the 10-inch to 40 calibers in the 4-, 5- and 6-inch guns. Comparing these with guns of the same caliber in Table II, it will be seen that the smaller guns have been raised from 40 to 50 calibers in length, and the larger ones from 30 to 35 up to 40 and 45 calibers. The lengthening of the guns is due to the difference in the two powders, the brown being quicker-burning (the charge taking less time to be converted into gas and therefore requiring less length of bore to develop its full accelerating energy upon the shell), the smokeless powder, on the other hand, being what is known as a slow-burning powder, and calling for greater length of bore in order to enable the combustion of the powder to be completed before the shell leaves the muzzle. It will be noticed that though the guns given in Table I were built for the use of brown powder, the ballistic data are worked out for charges of smokeless powder, the intention being that in the future only this kind of powder shall be used in our navy.

A comparison of velocities and energies achieved respectively by the old and new patterns of the guns shows the improved ballistics resulting from the large powder-chamber and great length of bore which characterizes the new type. Thus the 50-caliber 4-inch gun has a muzzle velocity of 3000 foot-seconds as against 2200 foot-seconds for the 40-caliber guns. The velocity of the 10-inch guns mounts from 2200 foot-seconds to 2800 foot-seconds, and that of the 12-inch from 2300 to 2800 foot-seconds, the increase in the muzzle energy in each case being in proportion. It is interesting, moreover, to compare the 35-caliber 12-inch gun firing smokeless powder with the same gun when firing the old brown powder. In the former case the muzzle energy was 25,990 foot-tons; with smokeless powder this same gun shows a muzzle energy of 31,170 foot-tons, while the new 40-caliber 12-inch gun with its larger powder-chamber shows a muzzle energy of 46,246 foot-tons, which, by the way, is 13,000 foot-tons greater than that of the 13-inch gun when firing brown powder, and 6000 foot-tons greater than the same gun when firing smokeless powder.

The new guns are to be fitted with an improved type of breech-mechanism, invented originally by Welin, a Swedish engineer, and by him sold to the Vickers Company in England, from whom the United States has purchased the patent rights for this country for the sum of $200,000. In the new breech-block, by cutting the threads with varying radii, it has been possible to reduce the length of the block by 30 or 40 per cent and thus save a great weight and bulk of metal in the body of the gun itself, besides securing a lighter breech-block, and one more easily and speedily manipulated. The mounting of the guns of the 6-inch caliber will be similar to that of the Vickers gun, with certain improvements incorporated by the Bureau.

In closing we would draw attention to an instructive comparison in the tables between the perforation through Harveyized armor and through the new Krupp armor, from which we learn, for instance, that while the new 12-inch gun can perforate 23.42 inches of Harvey armor at the muzzle, it is only capable of perforating at the muzzle 18.75 inches of the Krupp armor, the superiority of the Krupp armor being proportionately marked in the case of all other guns, whether it be at the muzzle or at the 1000-, 2000- or 3000-yards range. We commend this comparison to those Congressmen who are seeking to prevent the country from the purchase of Krupp armor at the reasonable price of $500 per ton demanded by our manufacturers.—*Scientific American.*

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ANNUAL REPORT OF THE SECRETARY AND TREASURER OF THE U. S. NAVAL INSTITUTE.

To the Officers and Members of the Institute:

Gentlemen:—I have the honor to submit the following report for the year ending December 31, 1899:

Itemized Cash Statement.

Receipts During Year 1899.

Items	First Quarter.	Second Quarter.	Third Quarter.	Fourth Quarter.	Totals.
Dues	$206 10	$213 12	$970 60	$729 95	$2119 77
Subscriptions	177 58	193 00	204 64	176 45	751 67
Sales	56 44	72 30	106 36	68 60	303 70
Interest on bonds and deposits	164 22	29 86	45 50	9 00	248 58
Advertisements	76 25	253 50	60 00	85 00	474 75
Cash in exchange for check.	10 00	..	..	..	10 00
Certificate Washg. Loan and Trust Co	1063 46	..	..	..	1063 46
Life members fee	..	60 00	90 00	30 00	180 00
Profit and loss	..	1 25	..	..	1 25
Binding	..	6 45	19 00	12 00	37 45
Revenue stamps	..	..	02	..	02
Premium on draft	..	..	..	48	48
Totals	$1754 05	$829 48	$1496 12	$1111 48	$5191 13
Receipts from extra publications					3001 36
Total					$8192 49

EXPENDITURES DURING YEAR 1899.

Items.	First Quarter.	Second Quarter.	Third Quarter.	Fourth Quarter.	Totals.
Printing and binding	$ ..	$1320 97	$529 61	$660 54	$2511 12
Salaries	282 40	334 00	300 00	300 00	1216 40
Postage	49 41	78 42	66 69	54 90	249 42
Freight and hauling	4 25	9 25	4 54	4 52	22 56
Expressage	4 12	11 51	6 96	15 81	38 40
Telegrams	1 01	5 24	47	3 68	10 40
Stationery	32 20	31	72 45	41	105 37
Office furniture	14 25	..	..	..	14 25
Check exchange for cash	10 00	..	..	..	10 00
Cost of articles	95 00	40 00	130 00	50 00	315 00
Certificate surrendered to Washington Loan and Trust Co.	1063 46	..	..	..	1063 46
Office help	..	8 62	..	..	8 62
Bank discount on checks	..	40	2 80	1 70	4 90
Typewriting	..	5 00	..	..	5 00
Clerk's expenses in Washington	..	..	15	..	15
Insurance	..	..	28 00	..	28 00
Map paper	..	..	..	21 12	21 12
Revenue stamps	..	..	..	1 20	1 20
Purchase of back numbers and books	..	..	95	7 25	8 20
Totals	$1556 10	$1813 72	$1142 62	$1121 13	$5633 57

Paid on account of printing and binding extra publications	2402 39
Total	$8035 96

SUMMARY.

Balance of cash unexpended January 1, 1899	$4625 50
Total receipts for 1899	8192 49
Total available cash, 1899	$12817 99
Total expenditures, 1899	8035 96
Cash unexpended January 1, 1900	$4782 03
Cash held to credit of reserve fund	239 14
True balance January 1, 1900	$4542 89
Bills receivable for 1899	788 00
" " " back dues	834 00
" " " binding	13 60
" " " subscriptions	33 00
" " " sales	22 00
" " " advertisements	375 25
" " " sale of other publications	329 12

Value of back numbers, estimated	825 00
" " Institute property	100 00
	$7862 86
Liabilities for other publications	2514 00
	$5348 86
Estimated value of other publications	3359 00
	$8707 86

Reserve Fund.

United States 4 per cent consols, registered	$900 00
District of Columbia 3.65 per cent registered bonds	2000 00
" " " coupon bonds	650 00
	$3550 00
Cash in bank uninvested	239 14
	$3789 14

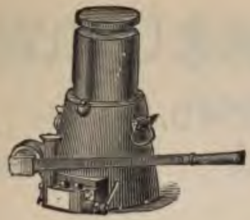
Membership.

Total membership January 1, 1899	858
" " " 1, 1900	885
Increase	27
Number of paper-bound copies of the Proceedings on hand at the end of the year	8508
Number of cloth-bound copies	1426
Total number of copies on hand	9934

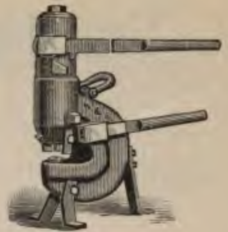
1 Vol. X, Part 1, bound in half-morocco.

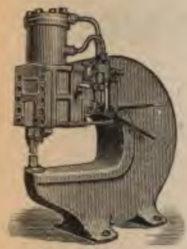
Very respectfully,

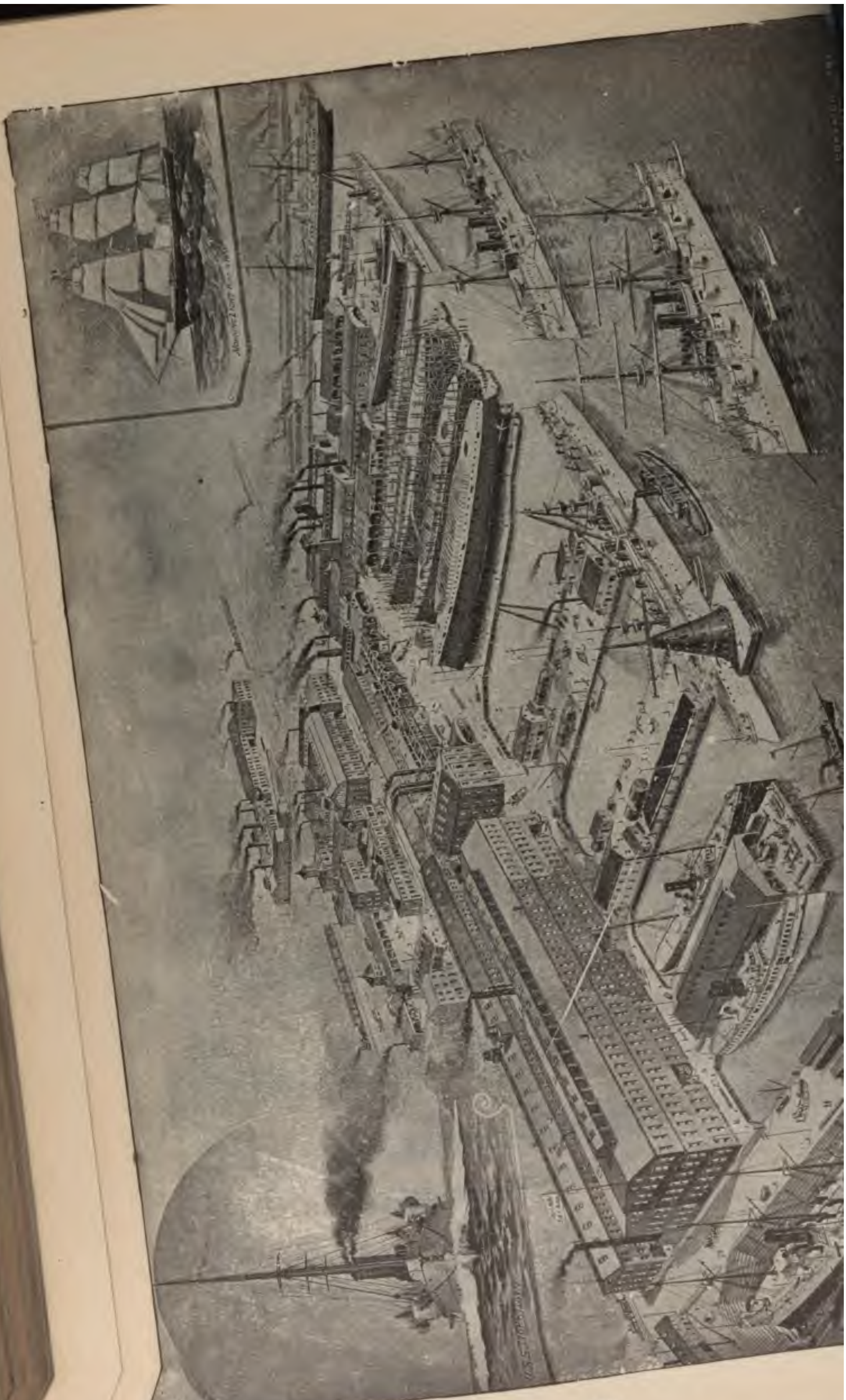
R. H. Jackson, *Lieutenant U. S. Navy,*
Secretary and Treasurer.



Horizontal Outside Pump Hydraulic Jack. Sheet 20.







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